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NFPA 820 Fire Protection in Wastewater Treatment and Collection Facilities 1992 Edition

NFPA®

National Fire Protection Association 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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NFPA 820

Recommended Practice for

Fire Protection in Wastewater Treatment and Collection Facilities

1992 Edition

This edition of NFPA 820, *Recommended Practice for Fire Protection in Wastewater Treatment and Collection Facilities*, was prepared by the Technical Committee on Wastewater Treatment Plants and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 18-20, 1991 in Montréal, Québec, Canada. It was issued by the Standards Council on January 17, 1992, with an effective date of February 10, 1992, and supersedes all previous editions.

The 1992 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 820

The Committee on Watewater Treatment Plants was organized in 1983 to have primary responsibility for documents on safeguarding against the fire and explosion hazards specific to wastewater treatment plants and associated collection systems. This includes the hazard classification of specific areas and processes. The need to develop NFPA 820 is based on fire or explosion incidents that are relatively severe when they occur, despite the frequency of these occurrences being low. Initial work on the document was begun early in 1985 and resulted in the first edition being issued in 1990. Extensive changes were made between the first edition and the 1992 edition, with the most notable revision being the document title, which was changed from *Recommended Practice for Fire Protection in Wastewater Treatment Plants* to *Recommended Practice for Fire Protection in Wastewater Treatment and Collection Facilities*. In addition, the document scope was revised to include storm sewer systems and their appurtenances.

Technical Committee on Wastewater Treatment Plants

James F. Wheeler, *Chairman*
U.S. Environmental Protection Agency, DC

Alphonse A. Abadir, U.S. Dept. of Labor, DC
John R. Anderson, Marshfield, MA
Alonza W. Ballard, Crouse-Hinds ECM, NY
Rep. Nat'l Electrical Manufacturers Assoc.
Brian J. Bowes, Plastic Pipe & Supply, Inc., RI
Alan J. Callier, Burns & McDonnell, MO
Rep. Water Pollution Control Federation
Michael P. Dyrness, Johnson and Higgins, WA
Jeffrey I. Enyart, American Concrete Pipe Assoc., VA
Henry R. Geoghegan, CH2M Hill, WA
Richard D. Gottwald, Society of the Plastics Industry, DC
John N. Harrell, Wilson & Co., Engineers & Architects, KS
Gary Hewitt, The Gorman-Rupp Co., OH
Rep. Waste & Wastewater Equip. Manu. Assoc., Inc.
John T. Higgins, DOW Corning Corp., MI
Rep. NFPA Industrial Fire Protection Section
John P. Hill, Factory Mutual Research Corp., MA
Garr M. Jones, Brown and Caldwell, CA
Edward S. Krupinski, Sedgwick James of Arizona, Inc., AZ
Charles E. Kudla, Underwriters Laboratories Inc., NC
Paul A. Kuhn, Greeley and Hansen, IL
James T. Nicol, Ansul, NH
Rep. Fire Suppression Systems Assoc.
James Retzloff, The Viking Corp., MI
Rep. Nat'l Fire Sprinkler Assoc.
Joseph P. Sheahan, Metro Water Reclamation District of Greater Chicago, IL
Rep. Assoc. of Metropolitan Sewerage Agencies
Edward Sikora, Nat'l Clay Pipe Institute, WI
Patrick J. Stella, John Bouchard & Sons, Co., TN
Dao T. Ton, Metropolitan Waste Control Commission, MN
Thomas J. Whiteman, E. B. Municipal Utility Dist., CA

Alternates

Dan Ryan, Underwriters Laboratories Inc., NC
(Alternate to C. E. Kudla)
Ralph S. Thomas, Metropolitan Waste Control Commission, MN
(Alternate to D. T. Ton)
David J. Vandeyar, National Fire Sprinkler Assoc., NY
(Alternate to J. Retzloff)

Casey C. Grant, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

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Fire Protection in Wastewater Treatment and Collection Facilities

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced in publications can be found in Chapter 11.

Chapter 1 Introduction

1-1 Scope.

1-1.1 General.

1-1.1.1 This recommended practice establishes guidelines for protection against fire and explosion hazards in wastewater treatment plants and associated collection systems, including the hazard classification of specific areas and processes. This document covers collection, trunk, intercepting, combined, and storm sewers and ancillary structures, pumping stations, wastewater treatment plants including sludge and chemical handling, and treatment facilities.

1-1.1.2 A fire risk evaluation should be initiated as early in the design process as practical to integrate the fire prevention and fire protection recommendations as described in this document into the plant-specific considerations regarding design.

1-1.2 Subjects not covered in this document:

(a) Collection, treatment, or disposal of industrial wastes or manufactured by-products that are treated on-site and not discharged to a public or privately operated municipal facility;

(b) On-site treatment systems (*see definition*);

(c) Pressure sewer systems (*see definition*);

(d) Building drain systems and appurtenances (*see definition*);

(e) Industrial sewer systems and appurtenances (*see definition*);

(f) Personnel safety from toxic and hazardous materials or products of combustion.

1-1.3 Alternative Methods. Nothing in this document is intended to prevent or discourage the use of alternative methods, materials, practices, or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the alternative method, material, practice, or device is equivalent to or superior to the recommendations of this document.

1-2 Purpose.

1-2.1 General. The purpose of this document is to provide guidance that addresses the hazards of explosion, fire, and related concerns at wastewater treatment plants and ancillary sewers and pumping stations. Appendix A provides a general overview and layout of the unit processes found at a typical wastewater treatment plant. It should be noted that the arrangement of the unit processes will vary from plant to plant.

1-2.2 Toxicity. This document addresses the fire and explosion hazards of various gases associated with wastewater treatment and conveyance; it does not cover toxicity. It should be recognized that, from a personnel safety standpoint, toxic gases can be present in life threatening concentrations while no threat of fire or explosion exists from those same gases.

1-2.3 Ventilation Practices. Where this document recommends certain ventilation practices, the recommendations are to minimize fire and explosion hazards and may be insufficient to protect personnel from the toxic effects of exposure to gases present.

1-2.4 Corrosion Considerations. Equipment and materials used in wastewater treatment plants are often subjected to deteriorating conditions such as being submerged in raw sewage, enclosed in warm, moist atmospheres, or exposed to corrosive chemicals or gases used in or produced as by-products of wastewater treatment processes. During the design phase, the use of corrosion-resistant equipment and materials should be considered where appropriate. However, since many of the corrosion-resistant materials and coatings are combustible or limited combustible and may represent a considerable fuel load during fire events, the design and fire risk evaluation should consider any additional hazards imposed by the use of these materials.

1-3 Application.

1-3.1* The recommendations in this document are intended for new installations. When significant additions or modifications are made to existing facilities, the modifications should reflect the recommendations of this document. In any event, the recommendations of this document should be used by owners in a risk assessment to identify areas of a treatment plant that may be vulnerable to fire or other loss that is able to be minimized with remedial protection.

1-3.2 This document is divided into eleven (11) chapters. Chapters 1, 6, 7, 8, 9, 10, and 11 generally apply. Chapters 2, 3, 4, and 5 apply to specific processes and functions. The appendixes provide explanatory information, and the paragraph designations used in Appendix A coincide with the paragraph numbers used in Chapters 1 through 11 to which the clarification is provided.

1-4 Metric Units of Measurement Guidance. For the purpose of this guidance, metric units of measurement are in accordance with the modernized metric system known as the International System of Units (SI). Values of measurement in the text will be followed by an approximate equivalent value in SI units. Tables will have a footnote for SI conversion units used in the table. For metric conversion practices, see ANSI Z210.1, *Standard for Metric Practices*.

1-5 Definitions.

Activated Carbon. Adsorptive carbon particles or granules usually obtained by heating carbonaceous material in the absence of air or in steam and possessing a high capacity to selectively remove trace and soluble components from solution.

Activated Sludge. A microbial mass grown in aeration tanks, subsequently separated from treated sewage by sedimentation, and wasted or returned to the process as needed.

Adjacent. Adjacent, as used in this document, means sharing a common wall, partition, or barrier.

Advanced (Tertiary) Wastewater Treatment. Any physical, chemical, or biological treatment process used to accomplish a degree of treatment greater than that achieved by secondary treatment. (*See Secondary Wastewater Treatment.*)

Anaerobic Digestion. A unit process designed to biologically convert organic matter (sludge) through the action of microorganisms in the absence of elemental oxygen. Process by-products include a gas containing methane, carbon dioxide, and small quantities of hydrogen sulfide. The digestion tank may have a fixed or floating roof system.

Anaerobic Waste Treatment. A unit process providing treatment of the liquid stream by action of microorganisms in the absence of elemental oxygen. Process by-products include a gas containing methane, carbon dioxide, and small quantities of hydrogen sulfide.

Approved. Acceptable to the "authority having jurisdiction."

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Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

Belt Filter. A sludge dewatering or concentrating device having continuous bands or belts of filtering media that pass around rollers and from which the material caught on the media is usually removed by gravity and pressure.

Building. A structure used or intended for supporting or sheltering any use or occupancy. Personnel may occupy buildings continuously or intermittently.

Building Drain. In plumbing, the part of the lowest horizontal piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer (house connection or lateral).

Combustible. Any material that does not comply with the definition of either noncombustible or limited combustible.

Combustible Gas Detectors. Combustible gas detectors detect the presence of flammable vapors and gases and warn when concentrations in air approach the explosive range.

Combustible or Explosive Dust. A dust capable of spontaneous combustion or of exploding or burning when subjected to a source of ignition.

Combustible Liquid. A liquid having a flash point at or above 100°F (37.8°C). (*See NFPA 30, Flammable and Combustible Liquids Code.*)

Compost. The product of thermophilic biological oxidation of sludge or other organic materials.

Dissolved Air Flotation. A separation process in which air bubbles emerging from a supersaturated solution become attached to suspended solids in the liquid undergoing treatment and float them up to the surface.

Domestic Wastewater. Wastewater derived principally from dwellings, commercial establishments, institutions, and the like. It may or may not contain small amounts of groundwater, surface water, or storm water.

Dry Wells. That portion of a pumping station designed to provide isolation and shelter or accommodations for controls or equipment associated with pumping of

wastewater. Dry wells are designed to completely and permanently exclude wastewater or wastewater derived atmospheres. Dry wells may contain accidental leakage of wastewater from shaft seals or occasional spills. A dry well may contain equipment such as pumps, motors, fans, wiring, controls, lights and associated wiring devices, and other accessories.

Drying Beds. Confined, underdrained, shallow layers of sand or gravel on which digested sludge is distributed for draining and air drying. Also applied to underdrained, shallow diked earthen structures used for drying sludge.

Enclosed. The interior of any tank or unit process that is closed to the atmosphere (excluding vents or pressure relief), or the area around any open tank or unit process surrounded by a building or other structure constructed with a roof and solid walls.

Equipment. A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as part of, or in connection with, a mechanical, instrumentation, or electrical installation.

Equipment Enclosure. The housing that covers, protects, or guards a piece of equipment and is not intended for personnel occupancy, but may provide for access to the equipment.

Explosionproof Apparatus. Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

Explosive Limits. The minimum concentration of a gas-air or vapor-air mixture that supports flame, if ignited, is known as the lower explosive limit (LEL). The maximum concentration of a gas-air or vapor-air mixture that, if ignited, supports flame is known as the upper explosive limit (UEL). Above the UEL and below the LEL, ignition cannot take place. (These values may change in oxygen-enriched atmospheres.)

Filter (Pressure or Gravity). A device used to pass liquid through a medium to remove suspended solids.

Filter Press. A unit process using a plate and frame press, operated hydraulically and mechanically, to produce a semi-solid sludge cake from a slurry.

Fire Barrier. A continuous membrane, either vertical or horizontal, such as a wall or floor assembly, that is designed and constructed with a specified fire resistance rating to limit the spread of fire and that will also restrict the movement of smoke. Such barriers may have protected openings.

Fire Loading. The amount of combustibles present in a given area, expressed in Btu/sq ft (kJ/m^2).

Fire Prevention. Measures directed toward avoiding the inception of fire.

Fire Protection. Methods of providing for fire control or fire extinguishment.

Fire Rated Penetration Seal. An opening in a fire barrier for the passage of pipe, cable, duct, etc., that has been sealed so as to maintain a barrier rating.

Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials*. This definition applies to the materials used in the construction of buildings, but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

Fire Stop. A through-penetration fire stop is a specific construction consisting of the materials that fill the opening around penetrating items such as cables, cable trays, conduits, ducts, and pipes and their means of support through the wall or floor opening to prevent spread of fire. Its rating is established in accordance with test procedures in ASTM E814, *Standard Method of Fire Tests of Through-Penetration Fire Stops*.

Flammable Liquid. Any liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (276 kPa) absolute pressure at 100°F (37.8°C). (*See NFPA 30, Flammable and Combustible Liquids Code.*)

Flash Dryer. A device for vaporizing water from partly dewatered and finely divided sludge through contact with a current of hot gas or superheated vapor. It includes a squirrel-cage mill for separating the sludge cake into fine particles.

Flash Mixer. A device for quickly dispersing chemicals uniformly throughout a liquid or semi-solid.

Flocculator. A unit process for the formation of floc in wastewater.

Fluidized Bed Reactor. A pressure vessel or tank that is designed for liquid-solid or gas-solid reaction; the liquid or gas moves upward through the solids particles at a velocity sufficient to suspend the individual particles in the fluid. Applications include ion-exchange, granular activated carbon adsorbers, and some types of furnaces, kilns, and biological contactors.

Force Main (Pressure Main). A pressure pipe connecting the pump discharge of a wastewater pumping station under pressure to a point of discharge.

Fuel Gases. Any gas used as a fuel source including natural gas, manufactured gas, sludge gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases. (*See NFPA 54, National Fuel Gas Code.*)

Galleries. Long tunnels or walkways connecting separate buildings or structures. Galleries are generally underground, without windows, and with limited entrances and exits. Galleries frequently contain gas, water, wastewater, and sludge piping, electrical wiring, and mechanical or electrical equipment.

Gas Handling Equipment. Gas handling equipment includes equipment for removal of gas evolved from the anaerobic digestion process and the compression, conditioning, or treatment of this gas. This equipment includes gas compressors, sediment traps, drip traps, gas scrubbers, and pressure regulating and control valves. Gas handling equipment does not include equipment or devices for the utilization of the gas, such as boilers, engines, and waste gas burners.

Grit Chamber. A detention chamber or an enlargement of a sewer designed to reduce the velocity of flow of the liquid to permit the separation of mineral from organic solids by differential sedimentation.

Hazardous (Classified) Location. Locations are classified depending on the properties of the flammable vapors, liquids, or gases or combustible dusts or fibers that may be present and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area is considered individually in determining its classification.

Hazardous Waste. Any waste that is potentially damaging to the environment or human health because of toxicity, ignitability, corrosivity, chemical reactivity, or other reason.

Heat Treatment. A sludge conditioning process combining high temperature, time, and pressure to improve the dewaterability of organic sludge.

Hydrogen Sulfide (H_2S). A toxic and lethal gas produced in sewers and digesters by anaerobic decomposition of wastewater solids or other anaerobic wastewater or sludge treatment processes.

Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, etc., where described in a particular Code requirement. Suitability of equipment for a specific purpose, environment, or application may be determined by a qualified testing laboratory, inspection agency, or other organization concerned with product evaluation. Such identification may include labeling or listing; see "Labeled" and "Listed."

Imhoff Tank. A deep, two-story wastewater treatment tank. It consists of an upper continuous-flow sedimentation chamber and a lower sludge-digestion chamber. The upper chamber floor slopes steeply to trapped slots through which solids may slide into the lower chamber. The lower chamber receives no fresh wastewater directly, but is provided with gas vents and with means for drawing digested sludge from near the bottom.

Incineration. Combustion or controlled burning of volatile organic matter in sludge and solid waste that reduces the volume of the material while producing heat, dry inorganic ash, and gaseous emissions.

Industrial Waste. Generally liquid, solid, or gaseous wastes originating from the manufacture of specific products. Such wastes are usually more concentrated, more variable in content and rate, and require more extensive or different treatment than municipal waste.

Intrinsically Safe. Intrinsically safe equipment and wiring are not capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific flammable or combustible atmospheric mixture in its most easily ignitible concentration. Abnormal conditions include accidental damage to any field-installed wiring, failure of electrical components, application of overvoltage, adjustment and maintenance operations, and other similar conditions. See ANSI/ISA RP 12.67, *Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations.*

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Limited Combustible. As applied to a building construction material, a material, not complying with the definition of noncombustible material, that in the form in which it is used has a potential heat value not exceeding 3500 Btu/lb (8.14×10^6 J/kg) (*see NFPA 259, Standard Test Method for Potential Heat of Building Materials*) and complies with one of the following paragraphs (a) or (b):

(a) Materials having a structural base of noncombustible material with a surfacing not exceeding a thickness of $\frac{1}{8}$ in. (3.175 mm) that has a flame spread rating not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through a material on any plane would have neither a flame spread rating greater than 25 nor evidence of continued progressive combustion as tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

Materials subject to increase in combustibility or flame spread rating beyond the limits herein established through the effects of age, moisture, or other atmospheric condition should be considered combustible. This definition applies to the materials used in the construction of buildings, but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Low Flame Spread. A material with a flame spread rating of 25 or less when classified in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

Manhole. (1) A structure atop an opening in a gravity sewer to permit personnel entry. (2) An opening in the top or side of an enclosed vessel to permit personnel entry (manway).

Methane (CH_4). A colorless, odorless, flammable gaseous hydrocarbon present in natural gas and formed by the anaerobic decomposition of organic matter. (*See also Anaerobic Digestion.*)

Nitrification Tank. A unit process for the oxidation of ammonia and nitrogen into nitrates through biochemical actions.

Noncombustible. A material that in the form in which it is used and under the conditions anticipated will not aid combustion or add appreciable heat to an ambient fire. Materials when tested in accordance with ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C (1382°F)*, and conforming to the criteria contained in Section 7 of the referenced standard shall be considered as noncombustible. This definition applies to the materials used in the construction of buildings, but does not apply to furnishings or the contents of buildings or to the fire hazard evaluation of materials.

Nonenclosed. Any tank or unit process open to the atmosphere, or the area around any open tank or unit process housed in a building or other structure constructed with a roof and at least 50 percent of the wall area open to the atmosphere. Fixed open louvered panels with effective openings greater than 50 percent of the wall area and evenly distributed over the wall area are considered open to the atmosphere.

On-Site Treatment. Self-contained systems that provide both treatment and disposal of wastewater on or immediately adjacent to a single or group of residences or small commercial establishments.

Oxygen-Enriched Atmosphere. Any atmosphere with an oxygen concentration greater than ambient by volume at normal atmospheric pressure, for example in oxygen-activated sludge systems, ozonation units, or high pressure oxidation units.

Ozonation. The process of contacting wastewater or air with ozone for the purpose of disinfection, oxidation, or odor control.

Physically Separated. Physically separated, as used in this document, means a gas-tight partition between two adjacent spaces, or two nonadjacent spaces, with no means of gas communication between the spaces. Personnel entry to the separate spaces should be by individual, grade level exterior access ports with no physical connection between the two.

Primary Wastewater Treatment. The first major treatment in a wastewater treatment plant, generally consisting of one or more of the following unit processes: screening, comminution or grinding, grit removal, sedimentation, and skimming.

Pumping Station. A structure that contains pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping wastewater or other liquid. Also called lift station.

Pyrolysis. The destructive distillation of organic compounds in an oxygen-free environment, converting the organic matter into gases, liquids, and char.

Recommended Practice. A document that is informative in nature and that may contain advisory recommendations, but that does not contain mandatory requirements.

Rotating Biological Contactor (RBC). A unit process for wastewater treatment that is composed of large, closely spaced plastic discs that are rotated about a horizontal shaft (usually a secondary biological treatment process).

Screening Chamber. A chamber or enlargement of a sewer where large suspended or floating solids or material is removed from raw wastewater by a screen.

Scum or Skimmings. Grease, solids, liquids, and other floatable material removed from settling tanks.

Secondary Wastewater Treatment. Wastewater treatment unit processes usually consisting of primary treatment and biological oxidation using activated sludge or trickling filtration, followed by clarification.

Sedimentation. The unit process of subsidence of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling, it may be enhanced by chemical addition, coagulation, and flocculation.

Sewer. A single or system of pipes or conduits that carries wastewater or drainage water. See definitions below for different types of sewers.

Branch. A sewer that receives wastewater from a relatively small area and discharges into a main sewer serving more than one branch-sewer area.

Building. In plumbing, the extension from the building drain to the public sewer or other place of disposal (also called house connection or lateral).

Collector. A pipe or conduit that receives wastewater from a relatively small area from two or more lateral sewers and that subsequently discharges into a trunk sewer.

Combined. A sewer intended to receive both wastewater and storm or surface water.

Industrial. A sewer intended to receive only industrial wastewater or other liquid or water-carried wastes (*also see sanitary sewer, storm sewer, and combined sewer*).

Interceptor. A sewer that receives dry-weather flow from a number of transverse sewers or outlets and frequently additional predetermined quantities of storm water (if from a combined system) and conducts such waters to a point for treatment or disposal (also called main sewer).

Outfall. A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge.

Pressure. A collection sewer that incorporates a sewage grinder pump or septic tank effluent pump to convey wastewater from a single or group of residences or small commercial establishments to a private or public sewer system or on-site disposal system.

Private. A sewer privately owned and used by one or more properties or owners.

Relief. (1) A sewer built to carry the flows in excess of the capacity of an existing sewer. (2) A sewer intended to carry a portion of the flow from a district in which the existing sewers are of insufficient capacity and thus prevent overtaxing the latter.

Sanitary. A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of storm, surface, and groundwaters that are not admitted intentionally.

Separate Sanitary. A sewer intended to receive only domestic wastewater (*also see combined sewer, sanitary sewer, and storm sewer*).

Storm. A pipe or conduit that carries storm water and surface water, street wash, and other wash water, or drainage, but excludes domestic wastewater and industrial wastes (also called storm drain).

Trunk. The principal pipe or conduit to which one or more collector sewers or branch sewers are tributary (also called main sewer).

Sewer Gas. Gas resulting from decomposition of organic matter in wastewater in sewers. Also, gas resulting from the incidental uncontrolled release of hydrocarbons or decomposition of organic matter in stagnant liquid and septic sludge in wastewater treatment plants. The gas may contain trace quantities of methane and hydrogen sulfide and may be low in oxygen. It may be both a fire and life safety hazard.

Should. Indicates a recommendation or that which is advised but not required.

Sludge. A semiliquid mass of accumulated settled solids deposited from wastewater, raw or treated, in tanks or basins.

Sludge Cake. A semisolid product of a sludge dewatering process.

Sludge Gas. Gas obtained as a by-product of the anaerobic sludge digestion unit process from the decomposition of organic matter. It has a high content of methane, varying amounts of carbon dioxide and hydrogen sulfide, and a small amount of nitrogen. It may be both a fire and life safety hazard.

Sludge Gas Vent. A passage to permit the controlled release of gases from anaerobic treatment processes or gas storage facilities.

Sludge Thickener. A tank or other equipment designed to concentrate wastewater sludges usually by gravity.

Sludge Treatment. The processing of wastewater sludges to render them stable. This may be done by aerobic or anaerobic digestion followed by drying on sand beds, filtering and incineration, filtering and drying, or wet air oxidation.

Structure. Structure, as used in this document, includes all construction designed to carry gravity loads and intended to contain wastewater, sludge, sludge gas, piping, or equipment. Structures may provide for access, but are not intended for continuous personnel occupancy.

Trickling Filter. A treatment unit process consisting of stone, plastic, redwood, or similar media over which wastewater is distributed and through which wastewater trickles to the underdrains and is treated by the microbial slimes formed on the surface of the media.

Utilization Equipment. Equipment that utilizes electric energy for mechanical, chemical, heating, lighting, or similar purposes.

Vacuum Filter. A unit process used to dewater wastewater sludge and consisting of a cylindrical drum mounted on a horizontal axis, covered with a media, and subjected to an internal vacuum.

Vault. An enclosed structure, usually underground, to permit personnel access to various types of equipment and instrumentation.

Ventilation Rate. Ventilation rate, as used in this document, is based on air changes/hour and is calculated by the use of 100 percent outside air for the supply air that must be exhausted. Air change/hour should be calculated on the basis of the maximum aggregate volume (under normal operating conditions) of the space to be ventilated.

Volatile Liquid. A liquid that evaporates readily at normal temperature and pressure.

Wastewater. The spent water of a community. Combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present.

Wet Well. That portion of the pumping station that receives and temporarily stores wastewater for the purpose of pumping. A wet well may or may not contain electrical equipment such as pumps, motors, fans, wiring and wiring devices, controls, lights, and other accessories.

Chapter 2 Collection Systems

2-1* General Information.

2-1.1 This chapter recommends guidelines for protection against fire and explosion hazards in the collection and transportation of municipal wastewater. This chapter does not address on-site systems, force mains, or those sewers

that convey principally industrial wastes. Table 2 lists locations, descriptions, electrical classifications, fire and explosion hazards, recommended materials of construction, recommended ventilation practices, and suggested fire protection measures associated with wastewater collection and transport systems. Detailed information on sources of hazards, sources of ignition, and potential mitigation measures associated with collection and transmission of municipal wastewater is contained in Chapter 6.

2-1.2 This chapter also contains additional information on specific hazards and considerations associated with the collection and transportation of municipal wastewater.

2-2 Sources of Hazards.

2-2.1 Fuel Gases. Fuel gases include natural gas, manufactured gas, sewer gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, mixtures of these gases, and floating flammable liquids. Some of these gases have specific gravities lower than that of air so that when released they will rapidly rise and diffuse above the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits. They may be considered as suffocating gases (*see the applicable sections of Chapter 6*).

2-2.2 Sewer Gases. These flammable and/or toxic gases result from the fermentation or decomposition of organic matter (*see the applicable sections of Chapter 6*).

2-2.3 Liquids. Disposal of waste chemical products through sewers and into wastewater treatment plants may be potential sources or contributing causes of fire and explosive conditions. Hydrocarbon liquids such as gasoline, kerosene, oils, and various chemicals either sent to sewers and drains or used for various applications at wastewater treatment plants may also provide flammable vapor concentrations at certain locations (*see the applicable sections of Chapter 6*).

2-3 Sources of Ignition. In general, the potential for ignition within the collection system occurs at points where liquids may enter or where personnel entry is possible. Therefore, manholes and pumping station wet wells are likely to present the greatest areas of concern. The introduction of ignition sources at these sites must be limited to those occasions following due life safety procedural mandates and always with adequate ventilation (*see the applicable sections of Chapter 8*).

2-4 Mitigation Measures. Mitigation of either hazards or potential ignition sources is achieved with a commonly preferred method of copious flushing with air (ventilation). In the event that a foreign combustible material enters the sewer system, removal by vacuum or coverage with foam may become necessary. Whenever possible, such entry is to be avoided by containment and adsorption. Appropriate use of a combustible gas detector is warranted as a minimal precaution preceding personnel entry into a collection system. The presence of toxic gases should also be considered when entering any confined space (*see the applicable section of Chapter 6*).

Table 2 Collection Systems

		A	B	C	D	E	F	G
		Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC-Area Electrical Classification (All Class I, Group D)	Material of Construction for Buildings or Structures (see 7-3)	Fire Protection Measures
1		MATERIALS USED IN REHABILITATION, RECONSTRUCTION, OR SLIP-LINING OF SEWERS	NA	NA	NA	NA	See Section 7-3	NA
2		INDUSTRIAL SEWER Sewer transporting industrial wastewater only. (No sanitary sewage)	Not included within the scope of this document.					
3		STORM SEWER Sewer transporting storm water only. (No sanitary sewage)	Possible ignition of flammable gases and floating flammable liquids	NNV	Inside of sewer	Division 2	See Section 7-3	NR
4		STORM WATER PUMPING STATION WET WELLS Liquid side of pumping station serving only a storm sewer system.	Possible ignition of flammable gases and floating flammable liquids	NNV	Entire room or space	Division 2	NC, LC, or LFS	CGD if enclosed
5	a	STORM WATER PUMPING STATION DRY WELLS Dry side of a pumping station serving only a storm sewer system.	Buildup of vapors from flammable or combustible liquids	D	Entire dry well	Division 2 or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure.	NC, LC, or LFS	FE
	b			C	Entire dry well when physically separated from wet well	UNCLASSIFIED		
6		PRESSURE SEWER (Force main) Sewer under pressure. (Flooded discharge pipe from pump or tank)	Not included within the scope of this document.					
7		BUILDING SEWER (Lateral sewer or drain) Sewer serving a house or single building (plumbing) connected to a public system.	Not included within the scope of this document.					
8		ON-SITE SEWER Sewer serving one dwelling unit or a cluster (approx. 5), but NOT connected to a public system.	Not included within the scope of this document.					
9		ON-SITE PUMPING STATION Pumping station serving an on-site sewer system not connected to a public system. (Grinder pumps or septic tank effluent pumps)	Not included within the scope of this document.					

A - Ventilated at less than 12 air changes per hour
B - Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C - Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD - Combustible gas detection system
D - Ventilated at less than 6 air changes per hour
EHS - External hose system
FAS - Fire alarm system
FDS — Fire detection system
FE - Portable fire extinguisher
FSS - Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC - Limited combustible material
LFS - Low flame spread material
NA - Not applicable
NC - Noncombustible material
NNV - Not normally ventilated
NR - No recommendation
NOTE: Column letters and row numbers are for referencing table items

Table 2 (continued)

		A	B	C	D	E	F	G
		Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC-Area Electrical Classification (All Class I, Group D)	Material of Construction for Buildings or Structures (see 7-3)	Fire Protection Measures
10	a	ON-SITE PUMPING STATION Pumping station serving an on-site sewer system connected to a public system that is located in a public right of way. (Grinder pumps or septic tank effluent pumps)	Possible ignition of flammable gases and floating flammable liquids	A	Entire pump room or area	Division 1 (May be Division 2 for single or multiple residential dwellings only)	NC, LC, or LFS	NR
	b			B		Division 2		
11	a	DOMESTIC (RESIDENTIAL) SEPARATE SANITARY SEWER Sewer transporting primarily domestic wastewater.	Possible ignition of flammable gases and floating flammable liquids	NNV	Within enclosed space	Division 1 (May be Division 2 for single or multiple residential dwellings only)		NR
	b			B		Division 2	See Section 7-3	
12	a	DOMESTIC (RESIDENTIAL) WASTEWATER PUMPING STATION Pumping station serving domestic separate sanitary sewer. (Wet well only)	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1 (May be Division 2 for single or multiple residential dwellings only)	NC	CGD
	b			B	Entire dry well when physically separated from a wet well or separate structures	Division 2	NC, LC, or LFS	
13	a	DOMESTIC (RESIDENTIAL) WASTEWATER PUMPING STATION DRY WELLS Dry side of a pumping station serving a separate sanitary sewer or combined system.	Buildup of vapors from flammable or combustible liquids	D	Entire dry well when physically separated from a wet well or separate structures	Division 2	NC, LC, or LFS	FE
	b			C		UNCLASSIFIED		
14		OUTFALL SEWER Final discharge pipe, from a treatment plant, transporting treated wastewater.	NA	NNV	NA	UNCLASSIFIED	NR	NR
15	a	SEPARATE SANITARY SEWER Sewer transporting domestic, commercial, and industrial wastewater to a public treatment plant.	Possible ignition of flammable gases and floating flammable liquids	NNV	Inside of sewer	Division 1	See Section 7-3	NR
	b			B		Division 2		
16	a	COMBINED SEWER Sewer transporting domestic, commercial, and industrial wastewater and storm water to a public treatment plant.	Possible ignition of flammable gases and floating flammable liquids	NNV	Inside of sewer	Division 1	See Section 7-3	NR
	b			B		Division 2		
17	a	WASTEWATER PUMPING STATIONS WET WELLS Liquid side of a pumping station serving a separate sanitary sewer or combined system.	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1	NC, LC, or LFS	CGD
	b			B		Division 2		

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C – Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS — Fire detection system
NOTE: Column letters and row numbers are for referencing table items.
FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 2 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
18	a	WASTEWATER PUMPING STATION DRY WELLS Dry side of a pumping station serving a separate sanitary sewer or combined system.	Buildup of vapors from flammable or combustible liquids	D	Entire dry well when physically separated from a wet well or separate structures (see definition of physically separated)	Division 2 or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure	NC, LC, or LFS	FE
	b			C	Entire dry well when physically separated from a wet well or separate structures (see definition of physically separated)	UNCLASSIFIED		
19		ABOVE GRADE WASTEWATER PUMPING STATION Pump room physically separated with no personnel access to wet well. Pumping of sewage from a separate sanitary or combined sewer system through closed pumps and pipes.	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	EHS and FE
20	a	ABOVE GRADE WASTEWATER PUMPING STATION Pump room physically separated from wet well. Pumping of sewage from a separate sanitary or combined sewer system through closed pumps and pipes.	Buildup of vapors from flammable or combustible liquids	C	Entire space or room	UNCLASSIFIED	NC, LC, or LFS	EHS and FE
	b			D		Division 2 or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure		
21	a	ABOVE GRADE WASTEWATER PUMPING STATION Pump room not physically separated from wet well. Pumping of sewage from a separate sanitary or combined sewer system through closed pumps and pipes.	Possible ignition of flammable gases and floating flammable liquids	A	Entire space or room	Division 1	NC	EHS and FE
	b			B		Division 2	NC, LC, or LFS	
22	a	MANHOLES Access to sewer for personnel entry.	Possible ignition of flammable gases and floating flammable liquids	NNV	Inside	Division 1	See Section 7-3	For fire protection measures see Chapter 6
	b			B		Division 2		
23	a	JUNCTION CHAMBERS Structure where sewers intersect.	Buildup of vapors from flammable or combustible liquids	NNV	Inside	Division 1	See Section 7-3	For fire protection measures see Chapter 6
	b			B	Open & above grade or inside and ventilated	Division 2		
24		INVERTED SIPHONS Depressed section of gravity sewer.	Possible ignition of flammable gases and floating flammable liquids	NNV	Interior of inlet and outlet structures	Division 1	NC	NR
25		CATCH BASINS (Curb inlet) Inlet where street water enters a storm or combined sewer.	Buildup of vapors from flammable or combustible liquids	NNV	Enclosed space	Division 2	See Section 7-3	NR

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CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS — Fire detection system
NOTE: Column letters and row numbers are for referencing table items.

FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 2 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
26	a	DIVERSION STRUCTURES Structure where wastewater can be diverted.	Buildup of vapors from flammable or combustible liquids	NNV	Enclosed space	Division 1	See Section 7-3	For fire protection measures see Chapter 6
	b			B		Division 2		
27		ABOVE GRADE VALVE VAULT Physically separated from the wet well. Valves in vault in closed piping system.	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	FE
28	a	BELOW GRADE VALVE VAULT Physically separated from the wet well and with closed piping system.	Buildup of vapors from flammable or combustible liquids	NNV	Enclosed space	Division 2	NC, LC, or LFS	FE
	b			C		UNCLASSIFIED		
29	a	BELOW GRADE VALVE VAULT With an exposed sewage surface.	Possible ignition of gases and floating flammable liquids	NNV	Enclosed space	Division 1	NC	FE
	b			B		Division 2	NC, LC, or LFS	
30	a	CONTROL STRUCTURES Enclosed structure where sewage or storm water flow is regulated.	Buildup of vapors from flammable or combustible liquids	A	Enclosed space	Division 1	See Section 7-3	EHS (if not NC)
	b			B		Division 2		
31	a	WASTEWATER HOLDING BASINS Enclosed structures holding treated or partially treated wastewater temporarily.	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed space	Division 1	NC	NR
	b			B		Division 2	NC, LC, or LFS	
32		WASTEWATER HOLDING BASINS — LINED OR UNLINED Open structures holding storm water, combined wastewater, untreated or partially treated wastewater.	NR	NR	NR	NR	NR	NR
33	a	BELOW GRADE METERING VAULT Physically separated from the wet well and with closed piping system.	Buildup of vapors from flammable or combustible liquids	NNV	Enclosed space	Division 2	NC, LC, or LFS	FE
	b			C		UNCLASSIFIED		
34	a	BELOW GRADE METERING VAULT With an exposed sewage surface.	Possible ignition of flammable gases and floating flammable liquids	NNV	Enclosed space	Division 1	NC	FE
	b			B		Division 2	NC, LC, or LFS	
35		COARSE AND FINE SCREEN FACILITIES (See Coarse and Fine Screen Facilities, Table 3)						

A - Ventilated at less than 12 air changes per hour
B - Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C - Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD - Combustible gas detection system
D - Ventilated at less than 6 air changes per hour
EHS - External hose system
FAS - Fire alarm system
FDS — Fire detection system
FE - Portable fire extinguisher
FSS - Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC - Limited combustible material
LFS - Low flame spread material
NA - Not applicable
NC - Noncombustible material
NNV - Not normally ventilated
NR - No recommendation

NOTE: Column letters and row numbers are for referencing table items.

Chapter 3 Liquid Stream Treatment Processes

3-1 General Information.

3-1.1 This chapter recommends guidelines for protection against fire and explosion hazards associated with liquid stream treatment processes. This chapter does not address treatment systems serving individual structures or treatment systems that treat principally industrial wastes. Table 3 lists locations, descriptions, electrical classifications, fire and explosion hazards, recommended materials of construction, recommended ventilation practice, and suggested fire protection measures associated with liquid stream treatment processes. Detailed information on sources of ignition, sources of hazards, and mitigation measures associated with liquid stream treatment processes is contained in Chapter 6.

3-1.2 This chapter also contains additional information on specific hazards and considerations associated with liquid stream treatment processes.

3-2 Sources of Hazards.

3-2.1 Fuel Gases. Fuel gases include natural gas, manufactured gas, sludge gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases and floating flammable liquids. Some of these gases have specific gravities lower than that of air so that when released they will rapidly rise and diffuse above the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits. They may be considered as suffocating gases (*see the applicable sections of Chapter 6*).

3-2.2 Sewer Gases. These flammable gases result from the fermentation or decomposition of organic matter. Explosive conditions (especially concerning the screening, degritting, and primary clarification processes) may result when these gases are mixed with air (*see the applicable sections of Chapter 6*).

3-2.3 Liquids. Disposal of waste chemical products through sewers and into the wastewater treatment plant may be potential sources or contributing causes of fire and explosive conditions. Hydrocarbon liquids such as gasoline, kerosene, oil, floating scum, and various chemicals either sent to sewers and drains or used for various applications at wastewater treatment plants may also provide flammable vapor concentrations at certain locations (*see the applicable sections of Chapter 6*).

3-3 Sources of Ignition. In general, the potential for ignition within the liquid stream of a treatment plant is restricted to flammable materials entering the start of the treatment process and to flammable gases generated as by-products of wastewater decomposition in nonflowing or septic portions of the liquid stream. Introduction of ignition sources into these areas should be limited, and adequate ventilation should always be provided (*see the applicable sections of Chapter 8*).

3-4 Mitigation Measures. Mitigation of either hazards or potential ignition sources is achieved with a commonly preferred method of copious flushing with air (ventilation). Use of a combustible gas detector at the first enclosed treatment process is recommended as a minimal precaution. The presence of toxic or hazardous gases should also be considered when entering any confined space (*see the applicable sections of Chapter 6*).

3-5 Unit Processes. Special consideration should be given to the following unit processes associated with liquid stream wastewater treatment.

3-5.1 Pumping stations that handle raw wastewater should be classified in the same manner as wastewater pumping stations (Chapter 2). In-plant pumping stations should be classified depending upon their location in the process train and the type of material handled. Restrictive classifications are generally not necessary for pumping stations that handle fully treated wastewater.

3-5.2 Grit chambers or screenings equipment that are housed in a building or in below-grade pits may be subject to the same fire and explosion hazards as pumping station wet wells.

3-5.3 Imhoff tanks and other similar processes may combine the wastewater liquids and solids treatment streams in a single vessel. Special consideration should be given to equipment located in or around Imhoff tanks or similar processes because of the generation of methane gas from anaerobic solids digestion processes within the vessel and the possibility of volatile substances being released from the wastewater.

3-5.4 The primary sedimentation tank may collect and concentrate floating flammable liquids.

3-5.5 Secondary and tertiary sedimentation tanks and aeration tanks not preceded by primary sedimentation may be subject to the same fire and explosion hazards as primary sedimentation tanks because of the potential of floating flammable liquids collecting on the surface. Where bypassing of primary sedimentation is possible, although not normally utilized, secondary and tertiary sedimentation tanks and aeration tanks may not be subject to the same fire and explosion potential as primary sedimentation.

3-5.6 Unit processes employing oxygen-enriched atmospheres require special consideration. Covered facilities may be unclassified above the covering deck; however, any equipment or instrumentation housed under the cover within the reactor space should be suitable for exposure to volatile hydrocarbons in an oxygen-enriched atmosphere. Oxygen is not itself flammable; however, increased concentrations of oxygen greatly increase the fire hazard. Oxygen aeration tanks and other similar processes should be equipped with continuously operating hydrocarbons LEL monitoring devices that will automatically cut off oxygen supply and purge reactor gases with atmospheric air when 10 percent LEL conditions are registered.

3-5.7 Galleries and other connecting structures that contain pipes transporting flammable gases or liquids require special consideration in design and fire protection.

3-5.8 Plastic media or wood for trickling filters, rotating biological contactors, bio-towers, and other fixed film systems are not a significant hazard in normal operations; however, these materials are normally classified as combustible and may contribute a considerable fuel load if ignited under certain conditions, such as during maintenance and construction. Some fixed film treatment systems are anaerobic and produce a combustible gas by-product, which aggravates the hazard for such enclosures containing these materials.

Table 3 Wastewater Treatment Processes

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[2]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
1	a	COARSE AND FINE SCREEN FACILITIES Removal of screenings from raw wastewater.	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed — entire space	Division 1	NC	FE, EHS, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1,3]			
2		PUMPING STATIONS (See Collection Systems, Table 2)						
3	a	FLOW EQUALIZATION TANKS Storage of raw or partially treated wastewater.	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed — entire space	Division 1	NC	FE, EHS, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1,3]			
4	a	GRIT REMOVAL TANKS Separation of grit from raw wastewater.	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed — entire space	Division 1	NC	FE, EHS, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1,3]			
5	a	PRE-AERATION TANKS Conditioning of wastewater prior to further treatment.	Possible ignition of flammable gases and floating flammable liquids.	A	Enclosed — entire space	Division 1	NC	EHS and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1]			
6	a	PRIMARY SEDIMENTATION TANKS Separation of floating or settleable solids from raw wastewater.	Possible ignition of flammable gases and floating flammable liquids	A	Enclosed — entire space	Division 1	NC	EHS and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Envelope 18 in. around the exterior of the tank and 18 in. high extending 10 ft horizontally from the tank above grade			
7		AERATION BASIN, POND, LAGOON, OXIDATION DITCH, AEROBIC SUSPENDED GROWTH SYSTEMS Aerobic treatment of wastewater open to the atmosphere.		NA		UNCLASSIFIED	NR	EHS

NOTE 1: Beyond envelope is unclassified.
NOTE 2: 1 ft = 0.3048 meter.
NOTE 3: Where liquid turbulence is not induced by aeration or other factors, the recommended envelope is 18 in. around the exterior of the tank and an 18 in. high envelope extending 10 ft horizontally from the tank above grade.
NOTE 4: Column letters and row numbers are for referencing table items.

A – Ventilated at less than 12 air changes per hour
B – Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C – Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS – Fire detection system
FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 3 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[2]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
8	a	ENCLOSED AERATION BASIN OR AEROBIC SUSPENDED GROWTH SYSTEMS Aerobic treatment of wastewater not preceded by primary treatment.	Possible ignition of flammable gases or floating flammable liquids	A	Entire enclosed space not routinely entered by personnel	Division 1	NC	NR
	b			B		Division 2	NC, LC, or LFS	
9		ENCLOSED AERATION BASIN OR AEROBIC SUSPENDED GROWTH SYSTEMS Aerobic treatment of wastewater preceded by primary treatment	NA	NR	Entire enclosed space	UNCLASSIFIED	NC, LC, or LFS	NR
10		TRICKLING FILTER, RBC, BIO-TOWER, AEROBIC FIXED FILM SYSTEMS Aerobic biological treatment of wastewater.	Not normally a significant hazard, however these processes may contain materials that are combustble under certain conditions	NA		UNCLASSIFIED	NR	EHS
11	a	ANAEROBIC TOWERS, ANAEROBIC FIXED FILM SYSTEM Anaerobic biological treatment if sealed from atmosphere.	Normally produces combustible gas as treatment process by-product	NA	Tank interior	Division 1	NC	FE and EHS
	b			NA	10 ft envelope around tank	Division 2	NC, LC, or LFS	
12	a	GAS HANDLING SYSTEMS FOR LIQUID TREATMENT PROCESSES	Combustible gas, often under pressure	A	Enclosed — entire space	Division 1	NC	FE and EHS
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment[1]			
13		OXYGEN AERATION TANKS Tanks for aerobic treatment of wastewater using high purity oxygen rather than air.	Ignition of flammable gases and floating flammable liquids in an oxygen-enriched environment	NA	Enclosed space	Division 2 (If unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification)	Any equipment or material within the reactor space should be safe for exposure to volatile hydrocarbons in an oxygen-enriched atmosphere	Special provision for LEL monitoring and automatic isolation of equipment and oxygen supply
14		INTERMEDIATE, SECONDARY, OR TERTIARY SEDIMENTATION TANKS Separate floating and settleable solids from wastewater at various treatment stages.		NA	NA	UNCLASSIFIED (For Division 2, if unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification)	NR	EHS
15		FLASH MIXER OR FLOCCULATION TANK Tanks for mixing various treatment chemicals with wastewater.		NA	NA	UNCLASSIFIED (For Division 2, if unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3 for classification)	NR	EHS

NOTE 1: Beyond envelope is unclassified.
NOTE 2: 1 ft = 0.3048 meter.
NOTE 3: Where liquid turbulence is not induced by aeration or other factors, the recommended envelope is 18 in. around the exterior of the tank and an 18 in. high envelope extending 10 ft horizontally from the tank above grade.
NOTE 4: Column letters and row numbers are for referencing table items.

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CGD – Combustible gas detection system
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EHS – External hose system
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FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 3 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[2]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
16		NITRIFICATION AND DENITRIFICATION TANKS Tertiary treatment of wastewater to reduce or remove nitrogen.		NA	NA	UNCLASSIFIED (For Division 2, if unit process is not preceded by primary sedimentation, refer to primary sedimentation in Table 3-1 for classification)	NR	EHS
17		BREAKPOINT CHLORINATION TANKS AND CHLORINE CONTACT TANKS Application of chlorine in aqueous solution to wastewater.		NA	NA	UNCLASSIFIED	NR (These unit processes use corrosive chemicals that require the use of specific materials of construction. Special consideration should be given to these materials of construction.)	EHS
18		AMMONIA STRIPPING TOWERS	(See trickling filter in Table 3)	NA	NA	UNCLASSIFIED	NR (These unit processes use corrosive chemicals. Special consideration should be given to materials of construction.)	EHS
19		INTERMEDIATE OR FINAL PUMPING STATIONS Pump(s) at intermediate stage or end of the treatment process.		NA	NA	UNCLASSIFIED	NR	EHS
20		GRAVITY AND PRESSURE FILTERS Filtering of treated wastewater through sand or other media.		NA	NA	UNCLASSIFIED	NR	EHS
21		CARBON COLUMN OR TANKS Vessels containing carbon for tertiary treatment of wastewater.	Significant hazard from combustible carbon material	NA	NA	UNCLASSIFIED	NR	EHS
22		ON-SITE OZONE GENERATION SYSTEM AND OZONE CONTACT TANKS Ozone generation and purification for disinfection of wastewater.	(Similar to oxygen generation with addition of being highly corrosive. See Table 5.)	NA	NA	Not covered in this document	NR	NR
23		BACKWASH WATER AND WASTE BACKWASH WATER HOLDING TANK Tanks for temporary storage of backwash water.	NA	NA	NA	UNCLASSIFIED	NR	EHS
24		ULTRAVIOLET DISINFECTION UNIT Disinfection of wastewater by ultraviolet radiation.		NA	NA	UNCLASSIFIED	NR	EHS
25		EFFLUENT STRUCTURES Various structures conveying treated wastewater away from treatment processes.		NA	NA	UNCLASSIFIED	NR	EHS

NOTE 1: Beyond envelope is unclassified.
NOTE 2: 1 ft = 0.3048 meter.
NOTE 3: Where liquid turbulence is not induced by aeration or other factors, the recommended envelope is 18 in. around the exterior of the tank and an 18 in. high envelope extending 10 ft horizontally from the tank above grade.
NOTE 4: Column letters and row numbers are for referencing table items.

A - Ventilated at less than 12 air changes per hour
B - Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C - Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD - Combustible gas detection system
D - Ventilated at less than 6 air changes per hour
EHS - External hose system
FAS - Fire alarm system
FDS - Fire detection system
FE - Portable fire extinguisher
FSS - Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC - Limited combustible material
LFS - Low flame spread material
NA - Not applicable
NC - Noncombustible material
NNV - Not normally ventilated
NR - No recommendation

Chapter 4 Solids Treatment Processes

4-1* General Information.

4-1.1 This chapter recommends guidelines for protection against fire and explosion hazards in the solids treatment processes. This chapter does not address treatment of solids from industrial waste treatment processes. Table 4 lists locations, descriptions, electrical classifications, fire and explosion hazards, recommended material of construction, recommended ventilation practice, and suggested fire protection measures associated with solids treatment processes. Detailed information on source of hazards, source of ignition, and potential mitigation measures associated with solids treatment processes is contained in Chapter 6.

4-1.2 This chapter also contains additional information on specific hazards and considerations associated with solids treatment processes.

4-2 Sources of Hazards.

4-2.1 Fuel Gases. Fuel gases include natural gas, manufactured gas, sludge gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases and floating flammable liquids on scum. Some of these gases have specific gravities lower than that of air so that when released they will rapidly rise and diffuse above the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits. They may be considered as suffocating gases (*see the applicable sections of Chapter 6*).

4-2.2 Sludge Gases. These flammable gases result from the fermentation or anaerobic decomposition of organic matter. Explosive conditions (especially concerning the anaerobic digestion process) may result when these gases are mixed with air (*see the applicable sections of Chapter 6*).

4-2.3 Liquids. Disposal of waste chemical products and scum skimmed from sedimentation tanks may be potential sources or contributing causes of fire and explosive conditions. Hydrocarbon liquids such as gasoline, kerosene, oil, and various chemicals and scum collected or used for various applications in the solids treatment process may also provide flammable vapor concentrations at certain locations (*see the applicable sections of Chapter 6*).

4-3 Sources of Ignition. In general, the potential for ignition within the solids treatment process is restricted to floating flammable materials skimmed from certain treatment processes and to flammable gases generated as by-products of anaerobic decomposition of sewage solids. Introduction of ignition sources into these areas should be limited, and adequate ventilation should always be provided (*see the applicable sections of Chapter 8*).

4-4 Mitigation Measures. Mitigation of either hazards or potential ignition sources is achieved with a commonly preferred method of copious flushing with air (ventilation). Use of a combustible gas detector at the anaerobic treatment process is recommended as a minimal precaution. The presence of toxic or hazardous gases should also be considered when entering any confined space (*see the applicable sections of Chapter 6*).

4-5 Unit Processes. Special consideration should be given to the following unit processes associated with solids treatment.

4-5.1 Scum pits collect scum and grease and other floating flammable liquids from the surface of sedimentation tanks. Special consideration should be given to equipment located in these areas because of potential explosion and fire hazards.

4-5.2 Sumps and tanks that collect drainage from anaerobic sludge treatment processes or that store, mix, and blend sludge may also collect significant volumes of sludge gas. Special consideration should be given to equipment located in these areas because of the potential for explosion.

4-5.3 Anaerobic digesters are unit processes specifically designed to produce sludge gas from the fermentation or anaerobic decomposition of organic matter. The sludge gas normally contains significant volumes of methane as a by-product of the anaerobic digestion process. Special consideration should be given to equipment located in and around anaerobic digesters because of the potential for explosion.

4-5.4 Solvent extraction and dehydration processes may produce a very dry organic dust as a by-product. Special consideration should be given to equipment located in dust handling areas because of the potential for explosion.

4-5.5 Incinerators used to burn scum or sludge cake are ignition sources when in operation. Special consideration should be given in construction of incineration buildings and in storage of combustible materials in incineration areas.

4-5.6 Sludge dewatering and sludge cake conveyance equipment generate sludge cake and convey it to its final destination (incineration, landfill, etc.). Dried cake can be a combustible material. Special consideration should be given in construction, operation, maintenance, and housekeeping of the equipment and surrounding areas.

Table 4 Solids Handling Processes

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[3]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
1		COARSE AND FINE SCREENINGS HANDLING BUILDINGS Storage, conveying, or dewatering of screenings. (No exposed flow of wastewater through this building or area)	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	EHS, FE, and FAS
2		GRIT HANDLING BUILDING Storage, conveying, and dewatering of heavy small screenings and grit. (No exposed flow of wastewater through this building or area)	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	EHS, FE, and FAS
3	a	SCUM HANDLING BUILDING OR AREA Holding, dewatering, or storage.	Possible grease or flammable liquids carryover	A	Enclosed space	Division 2	NC, LC, or LFS	EHS, FE, and CGD if enclosed
	b			B		UNCLASSIFIED		
	c			Not enclosed, open to atmosphere	NA			
4	a	SCUM PITS	Buildup of vapors from flammable or combustible liquids	A	Enclosed—entire space	Division 1	NC	EHS, FE, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1]			
5	a	SCUM PUMPING AREAS Pumping of scum, wet side of pumping station.	Carryover of floating flammable liquids	A	Enclosed — entire space	Division 1	NC	EHS, FE, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Within 10 ft envelope around equipment and open channel[1]			
6	a	SCUM PUMPING AREAS Pumping of scum, dry side of pumping station.	Not significant	D	Enclosed space	Division 2 or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure	NC, LC, or LFS	FE
	b			C		UNCLASSIFIED		
	c			Not enclosed, open to atmosphere	NA			
7		SCUM INCINERATORS[2] Elimination of scum through burning.	Fire box explosion from possible carryover of flammable scum	NR	Separated from scum storage	UNCLASSIFIED	NC, LC, or LFS	Indoor FSS and FE; Outdoor EHS and FE

NOTE 1: Beyond envelope is unclassified.
NOTE 2: See NFPA 82, NFPA 85A, B, and D, and NFPA 54.
NOTE 3: 1 ft = 0.3048 meter.
NOTE 4: Column letters and row numbers are for referencing table items.

A – Ventilated at less than 12 air changes per hour
B – Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C – Continuously ventilated at 6 changes per hour or as recommended in Chapter 8
CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS – Fire detection system
FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 4 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[3]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
8	a	SLUDGE THICKENER (CLARIFIER) Sludge concentration and removal, gravity or dissolved air flotation.	Possible generation of methane from sludge Carryover of floating flammable liquids	A	Enclosed — entire space	Division 1	NC	EHS, FE, and CGD if enclosed
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Envelope 18 in. above water surface and 10 ft horizontally from wetted walls[1]			
9		SLUDGE PUMPING DRY WELLS Pumping of sludge through closed pumps.	NA	NR	Not adjacent to a wet well	UNCLASSIFIED	NC, LC, or LFS	EHS and FE
10	a	SLUDGE PUMPING STATION DRY WELLS Dry side of a sludge pumping station.	Buildup of methane gas or flammable vapors	D	Entire dry well when physically separated from a wet well or separate structures	Division 2 or unclassified if adequate positive pressure ventilation from clean air is provided with effective safeguards against ventilation failure	NC, LC, or LFS	FE
	b			C	Entire dry well when physically separated from a wet well or separate structures	UNCLASSIFIED		
11	a	SLUDGE STORAGE WET WELLS, PITS, AND HOLDING TANKS Retaining of sludge.	Possible generation of methane gas in explosive concentrations Carryover of floating flammable liquids	A	Enclosed— entire space	Division 1	NC	CGD, EHS, and FE if tank enclosed in structure
	b			B		Division 2	NC, LC, or LFS	
	c			Not enclosed, open to atmosphere	Envelope 18 in. above water surface and 10 ft horizontally from wetted walls[1]		NC, LC, or LFS	NR
12	a	SLUDGE BLENDING TANKS AND HOLDING WELLS Retaining of sludge with some agitation.	Possible generation of methane gas in explosive concentrations Carryover of floating flammable liquids	A	Enclosed — entire space	Division 1	NC	EHS, FE, and CGD if tank enclosed in structure
	b			B		Division 2	NC, LC, or LFS	EHS, FE, and CGD if tank enclosed in structure
	c			Not enclosed, open to atmosphere	Envelope 18 in. above water surface and 10 ft horizontally from wetted walls[1]		NC, LC, or LFS	NR
13		DEWATERING BUILDINGS CONTAINING CENTRIFUGES, GRAVITY BELT THICKENERS, BELT AND VACUUM FILTERS, AND FILTER PRESSES Removal of water from sludge.	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	FE, FDS, and FAS
14		INCINERATORS [2] AND INCINERATOR BUILDINGS Burning of sludge cake.	Fire box explosion	NR	NA	UNCLASSIFIED	NC, LC, or LFS	Indoor FSS and FE; Outdoor EHS and FE

NOTE 1: Beyond envelope is unclassified.

NOTE 2: See NFPA 82, NFPA 85A, B, and D, and NFPA 54.

NOTE 3: 1 ft = 0.3048 meter.

NOTE 4: Column letters and row numbers are for referencing table items.

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CGD - Combustible gas detection system
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EHS - External hose system
FAS - Fire alarm system
FDS - Fire detection system
FE - Portable fire extinguisher
FSS - Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC - Limited combustible material
LFS - Low flame spread material
NA - Not applicable
NC - Noncombustible material
NNV - Not normally ventilated
NR - No recommendation

Table 4 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[3]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
15		HEAT TREATMENT UNITS, LOW OR HIGH PRESSURE OXIDATION UNITS Closed oxidation of sludge.	None, other than in high pressure systems	NR	NA	UNCLASSIFIED	NC, LC, or LFS	EHS and FE
16	**a**	ANAEROBIC DIGESTERS BOTH FIXED ROOF AND FLOATING COVER Generation of sludge gas by heating sludge.	Leakage of gas from piping and appurtenances	Not enclosed, open to atmosphere	Tank interior. Areas above and around the digester roof. Envelope 25 ft above the walls and 10 ft from any wall.	Division 1	NC	EHS and FE
	b			A	Digester tank enclosed (in a building)	Division 1	NC	CGD if enclosed
	c			B	Digester tank enclosed (in a building). Envelope 25 ft above the walls and 10 ft from any wall	Division 1	NC	CGD if enclosed
	d				Remaining space in enclosed area	Division 2	NC, LC, or LFS	
17	**a**	ANAEROBIC DIGESTER CONTROL BUILDING Storage, handling, or burning of sludge gas.	Leaking and ignition of sludge gas	A	Entire building	Division 1	NC	CGD, EHS, and FE
	b			C	Enclosed areas that contains gas handling equipment	Division 2	NC, LC, or LFS	
	c				Physically separated from above	UNCLASSIFIED	NC, LC, or LFS	
18	**a**	DIGESTER GAS PROCESSING ROOMS Gas compression, handling, and processing.	Sludge gas ignition	A	Entire room	Division 1	NC	CGD, EHS, and FE
	b			B		Division 2	NC, LC, or LFS	
19		ANAEROBIC DIGESTER GAS STORAGE Storage of sludge gas.	Gas storage piping and handling	NNV	See NFPA 54	See NFPA 54	NC, LC, or LFS	EHS, FE, and CGD
20		SLUDGE DEHYDRATION PROCESSING Chemical oxidation process.	Explosive dust, solvent drying, fertilizer processing hammer mills, dust handling equipment	NR	See NFPA 70	See NFPA 70	NC	EHS and FE
21		CHLORINE OXIDATION UNITS Chlorine reaction with sludge.	Chlorine is a very strong oxidizing agent	NR	NA	UNCLASSIFIED	NR (These unit processes use corrosive chemicals that require the use of specific materials of construction. Special consideration should be given to these materials of construction.)	EHS and FE

NOTE 1: Beyond envelope is unclassified.

NOTE 2: See NFPA 82, NFPA 85A, B, and D, and NFPA 54.

NOTE 3: 1 ft = 0.3048 meter.

NOTE 4: Column letters and row numbers are for referencing table items.

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CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS – Fire detection system
FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Table 4 (continued)

		A	B	C	D	E	F	G
		Location and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area[3]**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
22	a	UNDERGROUND (PIPING) TUNNELS CONTAINING NATURAL OR SLUDGE GAS PIPING Transmission of gas, sludge, water, air, and steam via piping and also may contain power cable and conduit.	Ignition of natural or sludge gases	D	Entire tunnel	Division 2	NC, LC, or LFS	CGD, FDS, and FE
	b			C	Areas within 10 ft of valves, meters, gas check valves, condensate traps, and other piping appurtenances	Division 2		
	c				Areas beyond 10 ft	UNCLASSIFIED		
23		UNDERGROUND (PIPING) TUNNELS NOT CONTAINING NATURAL OR SLUDGE GAS PIPING Transmission of sludge, water, air, and steam piping and also may contain power cable and conduit.	NA	NR	NA	UNCLASSIFIED	NC, LC, or LFS	FDS and FE
24	a	COMPOSTING PILES Aerobic sludge reduction.	Liberation of ammonia and toxic gas (composting materials may self-ignite)	D	Enclosed area	Division 2	NC, LC, or LFS	EHS and FDS
	b			C		UNCLASSIFIED		
25	a	IN-VESSEL COMPOSTING Aerobic sludge reduction.	Liberation of ammonia and toxic gas (composting materials may self-ignite)	As required by process	If enclosed, the interior of the reactor vessel plus a 10-ft envelope around the reactor vessel	Division 2	NC	EHS and FDS
	b				Areas beyond 10 ft	UNCLASSIFIED		

NOTE 1: Beyond envelope is unclassified.

NOTE 2: See NFPA 82, NFPA 85A, B, and D, and NFPA 54.

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CGD – Combustible gas detection system
D – Ventilated at less than 6 air changes per hour
EHS – External hose system
FAS – Fire alarm system
FDS – Fire detection system
FE – Portable fire extinguisher
FSS – Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC – Limited combustible material
LFS – Low flame spread material
NA – Not applicable
NC – Noncombustible material
NNV – Not normally ventilated
NR – No recommendation

Chapter 5 Chemical and Fuel Fire/Explosion Hazards

5-1 General Information.

5-1.1* This chapter recommends guidelines for protection against fire and explosion in the chemical and fuel storage and handling facilities. This chapter does not include gas utilization equipment, vehicle maintenance areas, or laboratories. Table 5 lists locations, descriptions, electrical classifications, fire and explosion hazards, recommended materials of construction, recommended ventilation practice, and suggested fire protection measures associated with chemical and fuel storage and handling facilities. Detailed information on sources of hazards, sources of ignition, and potential mitigation measures associated with chemical and fuel storage handling facilities is contained in Chapter 6.

5-1.2 This chapter also contains additional information on specific areas or unit operations associated with storage and handling of chemicals and fuels commonly used in municipal wastewater treatment plants.

5-2 Sources of Hazards.

5-2.1 Fuel Gases. Fuel gases include natural gas, manufactured gas, and mixtures of these gases used at the treatment plant. Some of these gases have specific gravities lower than that of air so that when released they will rapidly rise and diffuse above the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits. They may be considered as suffocating gases (*see the applicable sections of Chapter 6*).

5-2.2 Sludge Gases. These flammable gases result from the fermentation or anaerobic decomposition of organic matter. Explosive conditions (especially concerning compression and storage) may result when these gases are mixed with air (*see the applicable sections of Chapter 6*).

5-2.3 Liquids. Disposal of waste chemical products may be potential sources or contributing causes of fire and explosive conditions. Liquids such as gasoline, kerosene, oils, and other chemicals used for various applications may also provide flammable vapor concentrations at certain locations (*see the applicable sections of Chapter 6*).

5-3 Sources of Ignition. In general, the potential for ignition is restricted to reactive or flammable chemicals, liquid fuels, flammable natural fuel gases, and fuel generated as by-products for use in various unit processes or in the treatment plant. Introduction of ignition sources into these areas should be limited, and adequate ventilation should always be provided (*see the applicable sections of Chapter 8*). Chemicals and fuels should always be stored in accordance with safety codes and the manufacturer's instructions. Reactive chemicals should always be stored separately.

5-4 Mitigation Measures. Mitigation of either hazards or potential ignition sources is achieved with a commonly preferred method of copious flushing with air (ventilation). Use of a combustible gas detector at handling areas is recommended as a minimal precaution. The presence of toxic or hazardous gases from chemical reaction should also be considered when entering any confined space (*see the applicable sections of Chapter 6*).

5-5 Storage and Production Facilities. Special consideration should be given to the following facilities associated with the storage and production of chemicals and fuels used in the treatment of municipal wastewater.

5-5.1 Oxygen generation, storage, and handling facilities require special consideration. Although oxygen is not itself flammable, it does support combustion, and increased concentration of oxygen greatly increases the fire hazard (*see NFPA 50, Standard for Bulk Oxygen Systems at Consumer Sites*).

5-5.2 Ozone is generated by passing oxygen through an electric field. Like oxygen-generating facilities there is an increased fire hazard. Ozonation facilities require special consideration because of the extreme heat and electric field generated with the additional concern for the extreme corrosivity and toxicity of ozone (*see NFPA 50, Standard for Bulk Oxygen Systems at Consumer Sites*).

5-5.3 Chlorine is a very reactive chemical and requires special consideration in storing and handling. Chlorine in combination with other chemicals may produce sufficient heat to cause combustion of flammable materials. Chlorine and other reactive chemicals should always be stored separately (*see information from the Chlorine Institute*).

5-5.4 Activated carbon stored in bulk or in bags may provide a source of combustible material that can add a considerable fuel load if ignited. Special consideration should be given to equipment located in activated carbon handling areas or activated carbon storage facilities because of the potential for fire.

Table 5 Chemical and Fuel Fire/Explosion Hazards

	A	B	C	D	E	F	G
	Materials and Function	**Fire and Explosion Hazard**	**Ventilation**	**Extent of Classified Area**	**NEC-Area Electrical Classification (All Class I, Group D)**	**Material of Construction for Buildings or Structures (see 7-3)**	**Fire Protection Measures**
1	ALCOHOL Used in some tertiary treatment.	Flammable vapors	See NFPA 30				
2	CHLORINE (Gas) Chlorination of water.	Aids combustion, oxidizer, toxic	NR	NR	Refer to Chlorine Institute	NR (This equipment handles a corrosive chemical that requires the use of specific materials of construction. Special consideration should be given to these materials of construction.)	NR
3	OXYGEN (Used in aeration basins; see Chapter 3)	Aids combustion, oxidizer	See NFPA 50 and NFPA 53M			NR	NR
4	DIESEL FUEL, GASOLINE, AND MOTOR OILS Fuels for equipment.	Various	See NFPA 30 and NFPA 513			NR	Indoor FSS and FE; Outdoor FE
5	LP-GAS	Flammable gas	NR (stored outdoors)	See NFPA 58		NR	FE
6	OXYGEN GENERATION AND STORAGE	Aids combustion, oxidizer, oxygen-enriched areas	See NFPA 50 and NFPA 53			NR	Indoor FSS and FE; Outdoor EHS and FE
7	OZONE GENERATION	Aids combustion, oxidizer, toxic	See NFPA 50 and NFPA 53			NR	Indoor FSS and FE; Outdoor EHS and FE
8	ACTIVATED CARBON (Powdered or pulverized)	Combustible	NR	NR	NR	NR	NR

A - Ventilated at less than 12 air changes per hour
B - Continuously ventilated at 12 air changes per hour or as recommended in Chapter 8
C - Continuously ventilated at 6 air changes per hour or as recommended in Chapter 8
CGD - Combustible gas detection system
D - Ventilated at less than 6 air changes per hour
EHS - External hose system
FAS - Fire alarm system
FDS - Fire detection system
NOTE: Column letters and row numbers are for referencing table items.
FE - Portable fire extinguisher
FSS - Fire suppression system (automatic sprinkler, foam, gaseous, or dry chemical)
LC - Limited combustible material
LFS - Low flame spread material
NA - Not applicable
NC - Noncombustible material
NNV - Not normally ventilated
NR - No recommendation

Chapter 6 Fire and Explosion Prevention and Protection

6-1 Scope.

6-1.1 This chapter establishes recommended guidelines for overall protection against fire and explosion hazards in wastewater facilities and associated collection systems. The conditions created by the existence of gases, liquids, and solids can be grouped into two categories: (1) flammable/combustible, and (2) injurious to life. While this document deals primarily with the flammability aspects (including generation of toxic combustion products) of a particular substance, process, or area within a plant, additional precautions may be required to protect against other safety and health hazards. NFPA 70, *National Electrical Code*,® and NFPA *101*,® *Life Safety Code*,® contain additional information for those areas occupied by humans.

6-1.2 While this chapter contains general information on sources of hazards and sources of ignition commonly found at wastewater treatment plants, it does not contain all the specific information required to ensure adequate fire and explosion prevention and protection. Other documents from NFPA, as well as from other sources, provide specific information on sources of hazards and sources of ignition for various flammable/combustible products, materials, and equipment. The following documents contain additional information:

NFPA 30, *Flammable and Combustible Liquids Code*;

NFPA 31, *Oil Burning Equipment*;

NFPA 37, *Stationary Combustion Engines and Gas Turbines*;

NFPA 43A, *Liquid and Solid Oxidizers*;

NFPA 43C, *Gaseous Oxidizing Materials*;

NFPA 45, *Laboratories Using Chemicals*;

NFPA 49, *Hazardous Chemicals Data*;

NFPA 51, *Welding, Cutting and Allied Processes*;

NFPA 51B, *Cutting and Welding Processes*;

NFPA 53M, *Fire Hazards in Oxygen-Enriched Atmospheres*;

NFPA 54, *National Fuel Gas Code*;

NFPA 58, *Storage and Handling of LP-Gas*;

NFPA 59A, *Liquefied Natural Gas*;

NFPA 61A, *Starch Manufacturing and Handling*;

NFPA 68, *Deflagration Venting*;

NFPA 69, *Explosion Prevention Systems*;

NFPA 70, *National Electrical Code*;

NFPA 70B, *Electrical Equipment Maintenance*;

NFPA 70E, *Employee Electrical Safety*;

NFPA 77, *Static Electricity*;

NFPA 78, *Lightning Protection Code*;

NFPA 82, *Incinerators*;

NFPA 85A, *Fuel Oil- and Natural Gas-Fired Single Burner*;

NFPA 85C, *Multiple Burner Boiler-Furnaces*;

NFPA 85F, *Pulverized Fuel Systems*;

NFPA 91, *Exhaust Systems for Air Conveying of Materials*;

NFPA *101*, *Life Safety Code*;

NFPA 231, *General Storage*;

NFPA 321, *Classification of Flammable and Combustible Liquids*;

NFPA 327, *Cleaning Small Tanks*;

NFPA 328, *Manholes, Sewers, Flammable Liquids and Gases in;*

NFPA 329, *Underground Leakage of Flammable and Combustible Liquids*;

NFPA 395, *Storage of Flammable and Combustible Liquids on Farms and Isolated Construction Projects*;

NFPA 491M, *Chemical Reactions*;

NFPA 497A, *Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*;

API RP500A, *Classification of Locations for Electrical Installations in Petroleum Refineries*;

API RP500B, *Classification of Areas for Electrical Locations at Drilling Rigs and Production Facilities on Land and on Marine Fixed and Mobile Platforms*;

Chlorine Institute, *Properties of Chlorine.*

6-2 Sources of Hazard.

6-2.1 Fuel Gases and Chemicals. Fuel gases include natural gas, manufactured gas, sludge gas, liquefied petroleum gas-air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases. Some of these gases have specific gravities lower than that of air so that when released they will rapidly rise and diffuse above the point of leakage. Flammable mixtures are produced when these gases are mixed with air within certain limits, and since the oxygen content of each gas (when not mixed with air) is substantially low, they may be considered as suffocating gases. In addition the wastewater treatment plant uses

a variety of gaseous, solid, and liquid chemicals that by themselves or when mixed with oxygen or other chemicals may be a potential source of fire or explosion or both. Additional information on sources of hazards found at wastewater treatment plants is contained in the documents listed in 6-1.2.

6-2.2 Sewer Gas and Sludge Gases. These flammable gases result from the fermentation or decomposition of organic matter. Explosive conditions (especially concerning the anaerobic digestion process) may result when these gases are mixed with air.

6-2.3 Specialty Gases. Specialty gases utilized for (1) laboratory analysis and instrumentation calibration (hydrogen, methane, etc.), (2) wastewater treatment plant unit processes (chlorine, ozone, etc.), and (3) welding operations (acetylene, oxygen, etc.) may provide flammable/explosive conditions when either acting alone or mixed with other gaseous/organic substances.

6-2.4 Liquids. Disposal of waste chemical products through sewers and into wastewater treatment plants may be potential sources or contributing causes of fire and explosive conditions. Hydrocarbon liquids such as gasoline, kerosene, oils, and various chemicals either sent to sewers and drains or used for various applications at wastewater treatment plants may also provide flammable vapor concentrations at certain locations.

6-2.5 Solids and Combustible Dusts. Chemicals used in, or combustible dust by-products produced by, various wastewater treatment processes may be combustible or cause potential flammable and explosive conditions. Additional information on combustible solids and dusts is contained in Chapters 4 and 5 and the documents listed in 6-1.2.

6-2.6 Materials. Some materials used in wastewater treatment plants such as (1) wood, (2) plastic, (3) fiberglass-reinforced plastics (FRP), (4) paints and coatings, (5) insulating material, and (6) furnishings may either be combustible, limited-combustible, or low flamespread under certain conditions. Some of these materials can present a considerable fuel load if ignited; however, combustion characteristics of some materials can be altered to reduce their combustibility. Additional information on materials is contained in Chapter 7.

6-3 Conditions for and Sources of Ignition. The potential ignition of flammable gases, liquids, and solids (including dusts) that may be found at a wastewater treatment plant is limited by certain fundamental conditions. Gases and generated vapors must be mixed with air or oxygen to form a flammable mixture that requires heat of sufficient intensity for ignition. The ignition temperature of a combustible solid is influenced by the rates of air flow and heating as well as the geometry of the solid. Ignition may result from one or more of the following causes: (1) open flames and hot surfaces, (2) electrical arc, (3) sparks, or (4) chemical reaction. See Appendix B for properties of gases and vapors that may be present at wastewater treatment plants.

6-3.1 Open Flames and Hot Surfaces. Open flames and hot surfaces are potential means of ignition and may be encountered during operations and repairs or with malfunctioning equipment and appliances. Sources of ignition may include welding tasks, boilers, incinerators, kerosene-type lanterns, internal combustion engines, and smoking by humans.

6-3.2 Electrical Arc. Sustained arcing faults may cause extensive damage to electrical switchgear and motor control centers. This may provide sufficient heat to ignite flammable gases or vapors present or generated as a result of the arc (pyrolysis of insulating material).

6-3.3 Sparks. Sparks generated by (1) defective/worn electrical and mechanical equipment, (2) activities performed by personnel, and (3) static electricity may be a source of ignition for gases or flammable vapors.

6-3.4 Chemical Reaction. Fire and explosion may result due to the chemical reaction of substances that are (1) introduced in the wastewater treatment plant influent, (2) used for laboratory analyses, (3) required in various unit processes, and (4) produced as by-products. Potential chemical reactions may cause hazardous conditions that range in severity from the generation of flames (spontaneous combustion) to explosions.

6-4 Fire and Explosion Prevention. The principal control procedures used to minimize potential fire and explosion incidents at wastewater treatment plants include: (1) ventilation (*see Chapter 8 of this document*), (2) education (*see NFPA 1, Fire Prevention Code*), (3) risk management and property conservation programs, and (4) hot work permitting procedures.

6-4.1 Control of Hazardous Source. In-house training programs [Plant Emergency Organizations (PEO) and housekeeping/maintenance] for all employees should be established that will provide information to (1) understand, (2) identify, (3) prevent, and (4) handle hazardous sources or situations relating to potential fire, explosion, and toxicity problems. Close liaison should be implemented between the local fire department (including other authorized emergency personnel) and wastewater treatment plant safety personnel (*see 6-5.6, Fire Organization*) so that mutually approved emergency procedures (including familiarity of the plant) can be established.

6-4.2 Control of Ignition Sources.

6-4.2.1 All employees should be made familiar with the conditions for and sources of ignition outlined in Section 6-3 of this document in order to prevent/minimize the ignition of flammable gases and vapors. All employees should work to eliminate any source of open flames [*see 10-4(e)*].

6-4.2.2 Welding, cutting, and similar spark-producing operations should not be permitted until a written permit authorizing such work has been issued. The permit should be issued by a person in authority following his/her inspection of the area to assure that proper precautions have

been taken and will be followed until the job is completed. (*See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*)

6-5 Fire Protection Measures.

6-5.1 General. A fire risk evaluation should be initiated as early in the design process as practical to integrate the fire prevention and fire protection recommendations as described in this document into the plant-specific considerations regarding design.

6-5.2 Automatic Sprinkler Systems. Sprinkler systems should be installed where appropriate in buildings or structures located at a wastewater treatment plant. Specific design densities and system design criteria are not given in this document. The fire risk evaluation (*see 10-3.1*) should include detailed hazard classifications with system density and rates of application sufficient to suppress any anticipated fire. The use of NFPA 13, *Standard for the Installation of Sprinkler Systems*, other NFPA documents (*see 6-1.2*), and good engineering practices should be incorporated.

In certain areas of the wastewater treatment plant, such as chemical storage areas, underground tunnels or structures, or areas where electrical hazard is the principal concern, the use of other appropriate fire protection measures should be considered and carefully evaluated.

6-5.3 Foam, Halon, Carbon Dioxide, and Dry Chemical Systems. Foam and halon systems should be installed or used where appropriate in buildings or structures located at a wastewater treatment plant. Installation should be in accordance with NFPA 11, *Foam Extinguishment Systems*; NFPA 11A, *Medium- and High-Expansion Foam Systems*; NFPA 11C, *Mobile Foam Apparatus*; NFPA 12, *Carbon Dioxide Extinguishing Systems*; NFPA 12A, *Halon 1301 Systems*; NFPA 12B, *Halon 1211 Systems*; and NFPA 17, *Dry Chemical Extinguishing Systems*. These systems should be considered in chemical storage areas, underground tunnels or structures, or where electrical hazard is the principal concern and where water damage would seriously impair the integrity of the treatment plant.

6-5.4 Standpipes, Hose Streams, and Hydrants. Water supplies should be capable of delivering the total demand of sprinklers, hose streams, and foam systems. Standpipes, hose streams, and hydrants should be provided in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, and NFPA 22, *Standard for Water Tanks for Private Fire Protection*.

In areas where there is no public water supply or where the public water supply is inadequate, treatment plant effluent can be used for fire protection. In treatment plants with both a public water supply and a plant water system, the plant water system can be used as the principal source of water for the fire protection system, or it can be used as a backup to the public water supply system. Installation should be in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, and NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*.

When the plant water system is used as the principal source for fire protection, the system must be capable of providing adequate quantity and pressure and have sufficient standby capacity to meet all fire water flow requirements. If the plant water system is used as a backup to the public water supply, the system should provide easy access and connection for pumper equipment. Where dual hydrant systems are used, cross connections (where allowed) between the public water supply and the plant water system must be installed in accordance with local requirements to prevent contamination of the public water supply.

When fire pumps are the sole source of supply used in the plant water system, multiple pumps with sufficient capacity to meet fire water flow requirements with the largest pump out of service should be provided. Pumps should be automatic starting with manual shutdown and should not be subject to common failure (electrical or mechanical). Pumps should be provided in accordance with NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*.

6-5.5 Portable Fire Extinguishers. Portable fire extinguishers, where provided, should be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*. In some areas of the treatment plant, such as basements, underground pipe galleries connecting buildings, and other areas that are not occupied continuously, existing codes and standards may not be appropriate. In these cases the authority having jurisdiction should consider local optional requirements for portable fire extinguishers depending on frequency of occupancy, intended use and equipment contained in the space, and hazard potential for fire and/or explosion.

6-5.6 Fire Organization. Arrangements should be made to permit rapid entry into the plant by the municipal fire department, police department, or other authorized personnel in case of fire or other emergency. The Plant Emergency Organizations, where provided, should be instructed and trained according to NFPA 600, *Standard on Industrial Fire Brigades*, and the NFPA *Industrial Fire Brigade Training Manual*.

6-6 Fire Detection Systems.

6-6.1 Location. The location of the proper types of detection equipment (smoke, heat, flame, etc.) is a function of the hazard severity as identified in Tables 2, 3, 4, and 5 or other areas in the treatment plant where appropriate. Detectors should be installed in accordance with NFPA 72E, *Standard on Automatic Fire Detectors*. Location of combustible gas detection equipment is contained in Chapter 9.

6-6.2 Type of Equipment. Protective measures that will detect flame, heat, or smoke should be selected and installed in accordance with NFPA 72E, *Standard on Automatic Fire Detectors*, and the other documents listed in 6-1.2.

6-6.3 Detection and Alarm Systems. Where appropriate, central station, local protective auxiliary, remote station, or proprietary sprinkler waterflow alarms should be provided. Installation should be in accordance with NFPA 71, *Signaling Systems for Central Station Service* or NFPA 72, *Protective Signaling Systems*.

6-7 Special Fire Protection Measures.

6-7.1 Fire Protection during Construction. Fire protection measures during construction at both new and existing wastewater facilities should consider safety to life, protection of property, and potential for delays in construction as well as plant or unit process start up. Refer to NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, and other documents listed in 6-1.2.

6-7.2 Lightning Protection. Lightning protection should be provided for those structures having a risk index (R) of four (4) or greater when evaluated in accordance with Appendix I of NFPA 78, *Lightning Protection Code*.

Chapter 7 Materials and Types of Construction

7-1 Scope.

7-1.1 This chapter recommends materials of construction of buildings, structures, and process elements for protection against fire and explosion hazards in wastewater treatment facilities and associated collection systems. It does not include non-process contents of the structure or assembly where such contents are not part of the structure (*see Section 7-3*).

7-1.2 Other local approving authorities and governing codes may dictate more stringent requirements.

7-2 Materials.

7-2.1 No single material or coating will meet all conditions that may be encountered. Selection should be made for a particular application. New materials are continually being offered for use in wastewater treatment plant construction. Not all of them can be evaluated at this time. Accordingly, discussions in this chapter are generally confined to some of the more commonly used materials. Materials of construction can be classified for use in accordance with fire rating, flamespread value, and smoke density factors. In addition to the obvious danger to personnel and structure from explosion and fire, there exists the risk of exposure to an asphyxiating or toxic atmosphere. NFPA *101, Life Safety Code*, contains additional information.

7-2.2 For the purpose of this document, materials of construction can be divided into four basic categories: (1) combustible, (2) noncombustible, (3) limited-combustible, and (4) low flamespread. Construction materials being considered for wastewater treatment plants should be selected based on an overall evaluation including fire risk of the material attributes and the facility being designed. Refer to Chapter 10 and the following references for additional guidance:

(a) NFPA 220, *Standard on Types of Building Construction*;

(b) NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials*;

(c) NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*;

(d) NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*;

(e) NFPA 259, *Standard Test Method for Potential Heat of Building Materials*.

7-2.3 Materials of construction other than those recommended in this document may be considered in buildings or other structures that are fully sprinklered in accordance with 6-5.2.

7-3 Application.

7-3.1 The proper application of construction materials will not prevent explosion or fire hazards. The proper application may, however, reduce or eliminate effects of fire or explosion by maintaining structural integrity, controlling flamespread and smoke generation, preventing the release of toxic products of combustion, and maintaining serviceability and operation of the facility.

In general, recommendations for materials of construction do not apply to non-process contents of the structure or assembly where such contents are not part of the structure, including but not limited to: equipment or equipment enclosures, grating, walkways, ladders, railings, weirs, process piping and appurtenances, process media, aeration devices, slide and sluice gates, pump packing or seal materials, conduit, hardware, liners for basins that are open to the atmosphere, or materials used in rehabilitation or lining of existing sewer pipes.

7-3.1.1 Materials of construction and interior finishes should provide a maximum degree of fire resistance with a minimum flamespread and smoke generation for a particular application.

7-3.1.2 Sewers.

7-3.1.2.1 Storm sewers serving locations where there is limited possibility that significant quantities of flammable or combustible materials will enter the system, such as residential areas, pipes, manholes, junction chambers, catch basins, diversion structures, control structures, and other ancillary structures, may be constructed of all appropriate materials.

Storm sewers serving locations, such as residential areas, where there is a possibility that significant quantities of flammable or combustible materials may enter the system, pipes, manholes, junction chambers, catch basins, diversion structures, control structures, and other ancillary structures should be constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the system should be included in the fire risk evaluation.

7-3.1.2.2 Domestic residential separate sanitary sewers transporting primarily domestic wastewater and where significant quantities of flammable or combustible materials

are not expected to enter the system should have pipes, manholes, junction chambers, diversion structures, control structures, and other ancillary structures constructed of all appropriate materials.

7-3.1.2.3 Separate sanitary sewers transporting domestic, commercial, and industrial wastewater and where significant quantities of flammable or combustible materials may enter the system should have pipes, manholes, junction chambers, diversion structures, control structures, and other ancillary structures constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the wastewater treatment process and structural integrity of the system should be included in the fire risk evaluation.

7-3.1.2.4 Combined sewers transporting domestic, commercial, and industrial wastewater and storm water should have pipes, manholes, junction chambers, diversion structures, control structures, and other ancillary structures constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact a fire or explosion will have on the wastewater treatment process and structural integrity of the system should be included in the fire risk evaluation.

7-3.1.3 Pumping Facilities.

7-3.1.3.1 Storm water pumping facilities including wet wells, dry wells, valve vaults, and ancillary structures should be constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the facility should be included in the fire risk evaluation.

7-3.1.3.2 Domestic residential separate sanitary pumping facilities handling principally domestic wastewater, including wet wells, metering vaults, and valve vaults classified as Division 1, should be constructed of noncombustible materials. Wet wells, dry wells, metering vaults, and valve vaults classified as Division 2, or that are unclassified, may be constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

7-3.1.3.3 Pumping facilities handling domestic, commercial, and industrial wastewater, or combined wastewater, including wet wells, metering vaults, valve vaults, and other ancillary structures classified as Division 1, should be constructed of noncombustible materials. Wet wells, dry wells, metering vaults, valve vaults, and other ancillary structures classified as Division 2, or that are unclassified, may be constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the facility must be included in the fire risk evaluation.

7-3.1.3.4 Aboveground pumping facilities handling domestic, commercial, and industrial wastewater, or combined wastewater, including pump rooms and ancillary structures classified as Division 1, should be constructed of noncombustible materials. Pump rooms and ancillary structures classified as Division 2 or that are unclassified may be constructed of materials meeting the definition of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the facility should be included in the fire risk evaluation.

7-3.1.3.5 Small aboveground pumping facilities with a floor area of 100 sq ft or less and physically separated from the wet well that does not present a fire hazard to other buildings or structures may be constructed using all appropriate materials of construction.

7-3.1.4 Buildings and Structures.

7-3.1.4.1 In general, buildings and structures including domes and covers for areas classsified as Division 1 should be constructed of noncombustible materials. Buildings and structures including domes and covers for areas classified as Division 2 or for unclassified areas should be constructed of materials meeting the definitions of noncombustible, limited-combustible, or low flamespread.

When conditions or applications warrant the selection of combustible materials, consideration to flamespread, smoke generation, and the impact that a fire or explosion will have on the structural integrity of the facility should be included in the fire risk evaluation.

7-3.1.4.2 Small aboveground buildings or structures, including domes and covers that have a floor area 100 sq ft or less, that are not used to store combustible or flammable materials, and that do not represent a fire hazard to other buildings or structures, may be constructed using all appropriate materials of construction.

7-3.1.5 Critical Applications. Where appropriate, materials of construction meeting the definition for noncombustible should be used in all buildings or structures for unit processes that are considered *critical* to the integrity of the treatment plant (e.g., headworks pumping facility) and that if out of service for even a few hours could perma-

nently or unacceptably damage the environment or endanger public health by allowing the release of raw wastewater or sludge. Where structural assemblies and partitions are used in these areas for separation, they should have a minimum of a three-hour fire rating. Where practical, nonstructural assemblies such as ventilation ducts and piping should be constructed of noncombustible materials.

7-3.1.6 Important Applications. Where appropriate, materials of construction meeting the definition of noncombustible, limited-combustible, or low flamespread should be used in buildings or structures for unit processes that are considered *important* to the integrity of the treatment plant (e.g., biological treatment) and that if out of service for short periods of time would not permanently or unacceptably damage the environment or endanger public health, but would become critical if continued for several days. Where structural assemblies and partitions are used in these areas for separation, they should have a minimum of a two-hour fire rating. When selecting materials or coatings, consideration should be given to flamespread, smoke generation, and release of toxics during fire events.

7-3.1.7 Any appropriate materials of construction can be used in other areas of the treatment plant, where being out of service for longer periods of time (a week or more) would not permanently or unacceptably damage the environment or endanger public health. Where structural assemblies and partitions are used in these areas for separation, they should have a minimum fire rating of one hour and consideration should be given to flamespread, smoke generation, and release of toxics when selecting materials or coatings.

7-3.1.8 In general, noncombustible materials should be used for air supply and exhaust systems. However, where appropriate, ventilation systems may be constructed of limited-combustible or low flamespread materials. Systems supply or exhausting air at a rate greater than 2000 ft^3/min (56.6 m^3/min) should include listed smoke dampers, listed fire dampers, and smoke detection and should cause the ventilation system to shut down upon detection of smoke. Separate smoke ventilation systems are preferred; however, smoke venting can be integrated into normal ventilation systems using automatic or manually positioned dampers and motor speed control. (*See NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, and NFPA 204M, Guide for Smoke and Heat Venting.*) Smoke venting may also be accomplished through the use of portable smoke ejectors.

7-3.1.9 Cellular or foamed plastic materials should be used in accordance with NFPA *101, Life Safety Code*. Roof covering should be Class A in accordance with NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*. Metal roof deck construction, when used, should be "Class I" or "fire classified."

7-3.1.10 Plastic or fiberglass-reinforced plastic products are often used as a material of construction in unit processes such as rotating biological contactors (RBC), biotowers, trickling filters, inclined plate (tube) settlers, ventilation ducts, and other equipment that may be subject to corrosion. Under normal operating conditions these plastic or fiberglass-reinforced plastic materials may be submerged; however, during maintenance or repair they may become exposed. During maintenance and repair operation, extreme care should be taken with open flame such as cutting torches as these exposed plastic or fiberglass-reinforced plastic material may present a considerable fuel load if ignited. [*See 10-4(e).*]

7-3.1.11 In areas where corrosive environments are present, including classified areas, special attention is needed to mitigate corrosion problems in electrical equipment selection and use, including the use of corrosion resistant metallic or nonmetallic conduit and electric equipment.

7-4 Openings in Fire Barriers.

7-4.1 All openings in fire barriers should be provided with fire door assemblies, fire dampers, penetration seals (fire stops), or other approved means having a fire protection rating consistent with the designated fire resistance rating of the barrier. Windows in fire barriers (control rooms or computer rooms) should be provided with a fire shutter or automatic water curtain. Penetration seals provided for electrical and piping openings should be listed.

7-4.2 Fire door assemblies, fire dampers, and fire shutters used in rated fire barriers should be selected and installed in accordance with NFPA 80, *Standard for Fire Doors and Windows*.

7-4.3 Fire dampers may be omitted in fire barriers of one hour or less fire resistance rating (*see NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems*).

7-5 Drainage.

7-5.1 Provisions should be made in all fire areas of the plant for removal of all liquids directly to safe areas or for containment in the fire area without flooding of equipment and without endangering other areas. Caution should be taken to avoid washing hazardous or toxic products of combustion into the drainage system. (*See Appendix A of NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection.*) Drainage and prevention of equipment flooding should be accomplished by one or more of the following:

(a) Floor drains;

(b) Floor trenches;

(c) Open doorways or other wall openings;

(d) Curbs for containing or directing drainage;

(e) Equipment pedestals;

(f) Pits, sumps, and sump pumps.

7-5.2 The provisions for drainage and any associated drainage facilities should be sized to accommodate all three of the following simultaneously:

(a) The spill of the largest single container of any flammable or combustible liquids in the area;

(b) The maximum expected number of fire hose lines [500 gpm (31.5 L/sec) minimum] operating for a minimum of ten minutes;

(c) The maximum design discharge of fixed fire suppression systems operating for a minimum of ten minutes.

Chapter 8 Ventilation

8-1 General.

8-1.1 This chapter recommends minimum criteria for adequate ventilation for protection against fire and explosion of wastewater treatment and pumping facilities. Where this document recommends certain ventilation practices, the recommendations are to minimize fire and explosion hazards and may be insufficient to protect personnel from the toxic effects of exposure to gases present.

8-1.2 Other local jurisdictions and governing codes may dictate more stringent requirements.

8-1.3 This chapter is limited to ventilation of enclosed wastewater pumping and process-related areas. It does not establish criteria applicable to spaces devoted to administrative areas, laboratories, or other ancillary spaces.

8-1.4 This chapter does not apply to at or above grade unroofed structures less than 2 ft deep or 2 ft to the normal water line or to at or above grade roofed structures where: (1) the roof is at least 10 ft above surrounding finished grade, and (2) the structure is open on at least three sides.

8-1.5 Because of the unpredictable nature of materials and events that can be encountered in the operation of wastewater systems, suggested ventilation criteria may not be adequate for protection against all hazards that may be encountered.

8-1.6 Hazardous classifications as established in this recommended practice may be reduced in classification to unclassified with positive pressure purging as provided under Article 500 of NFPA 70, *National Electrical Code*. Positive pressure purging systems should be Type X purging systems as described in NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*.

8-2 Installation.

8-2.1 Ventilation systems serving spaces governed by this recommended practice should be designed in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, unless superseded by more restrictive provisions of this recommended practice. All equipment and systems should be installed and tested in accordance with the standards of the American Society of Heating, Refrigerating, and Air Conditioning Engineers, the requirements of the NFPA, and local fire codes.

8-2.2 Exhaust systems serving hazardous areas classified under the provisions of Article 500 of NFPA 70, *National Electrical Code*, should be designed and installed in accordance with Chapter 3 of NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*.

8-2.3 All mechanically ventilated spaces should be served by both supply and exhaust fans.

Exception No. 1: For covered process facilities that are not routinely entered by personnel and where mechanically ventilated, the space may be ventilated by exhaust fans only. In determining the area classification the induced supply (outside) air must meet the ventilation rate recommended by the applicable table.

Exception No. 2: Above grade spaces with floor areas of 100 ft^2 (9.3 m^2) or less meeting the recommendations of 7-3.1.3.5 or 7-3.1.4.2 may be ventilated by an exhaust fan only.

8-2.4 Ventilation systems serving unclassified areas adjacent to classified areas should maintain a positive pressure (relative to ambient) of not less than 25 Pa (0.1 in. water column) under all operating conditions.

8-2.5 Ventilation systems serving classified areas should maintain a negative pressure (relative to ambient) of not less than 25 Pa (0.1 in. water column) under all operating conditions.

8-2.6 Ventilation systems for hazardous areas designed to operate intermittently or only when the space is occupied are not considered adequate for the purpose of downgrading electrical classification of areas (*see Tables 2, 3, and 4*).

8-2.7 Air should be introduced into and exhausted from such spaces in a manner that will encourage scavenging of all portions of the spaces to avoid short-circuiting and promote the effective removal of both heavier- and lighter-than-air gases and vapors.

8-2.8 Ventilation systems designed to transfer air from unclassified interior spaces to classified interior spaces are not recommended.

8-2.9 Ventilation systems serving areas governed by this recommended practice should receive power from electrical equipment that receives power from a primary power source and that also has the means to accept power from alternate power sources. Minimum requirements for the means to accept the alternate source of power are connectors that are designed to connect to devices such as standby generators, portable generators, uninterruptable power supplies, etc. Automatic or manual switching to a permanent alternate source of power is also acceptable. Power failure of the primary source shall be alarmed so that appropriate emergency procedures can be started.

8-3 Ventilation Criteria.

8-3.1 Ventilation rates are based on air changes/hour and should be calculated on the basis of the maximum aggregate volume (under normal operating conditions) of the space to be ventilated. Air changes/hour should be based upon 100 percent outside supply air, which must be exhausted. Ventilation rates should conform to Table 8-3.

8-3.2 Dual ventilation rates for Class I, Division 1 and Division 2 areas may be permitted under the provisions of this document provided (1) the low ventilation rate is not less than 50 percent of Table 8-3; (2) the low ventilation rate is in operation only if the supply air temperature is 50°F or less; (3) the high ventilation rate is not less than Table 8-3; and (4) the high ventilation rate is in operation whenever the supply air temperature is above 50°F, whenever the ventilated space is occupied, or whenever activated by approved combustible gas detectors set to function at 10 percent of lower explosive limit.

Table 8-3 Recommended Minimum Ventilation Rates

The ventilation rates recommended in this table are considered to be the minimum necessary to reduce the possibility of accumulation of combustible vapors. Ventilation rates should be increased above those recommended if unusual accumulations of volatile combustible liquids or combustible vapors are expected or if toxic gases may be present.

Description	Ventilation Rate
Wet wells, screen rooms, and other enclosed space with wastewater exposed to atmosphere.[a]	12 air changes/hour[b]
Rooms or spaces intended for storage or conveyance of wastewater solids.	12 air changes/hour
Equipment rooms, dry wells, tunnels and other below grade spaces:	
With piping and equipment handling flammable gas.[a]	12 air changes/hour or 74 fpm velocity in tunnels or galleries.
Without gas piping.	6 air changes/hour or 37 fpm velocity in tunnels or galleries.

NOTE a: Combustible gas detection equipment recommended.
NOTE b: Consideration should be given to higher ventilation rates when the collection system serves a significant industrial area or is a combined system.

8-3.3 Recirculation of up to 75 percent of the exhaust air flow rate for unclassified areas may be permitted provided (1) the recirculated air and outside air flow rate total is not less than 6 air changes/hour, (2) recirculation does not occur during occupancy, and (3) recirculation does not occur whenever a combustible gas detector senses a lower explosive limit of 10 percent or greater.

8-3.4 Ventilation rates and procedures established by this recommended practice may not be sufficient to protect personnel from exposure to toxic gases that may be present in enclosed spaces.

8-3.5 Ventilation system designs should consider the effects of cold weather operation and the probable presence of corrosive agents.

8-4 Monitoring and Signaling Systems.

8-4.1 All continuous ventilation systems should be fitted with flow detection devices connected to alarm signaling systems to indicate ventilation system failure.

8-4.2 All ventilated enclosed spaces where wastewater is exposed to the atmosphere or where combustible gas is conveyed in pipelines under greater than atmospheric pressure should be equipped with approved combustible gas detection devices and alarm systems. The detectors should be set at 10 percent of the lower explosive limit in accordance with the manufacturer's calibration instructions and should be connected to alarm signaling systems.

8-4.3 Combustible gas detectors should be approved fail-safe types that alarm upon failure and loss of calibration. Combustible gas detectors should be resistant to poisoning by hydrogen sulfide gas.

8-4.4 Local and remote alarms for both ventilation system failure and combustible gas detection should be provided for all hazardous areas classified in accordance with Article 500 of NFPA 70, *National Electrical Code*, or any space purged in accordance with Tables 2, 3, 4, and 5 and Chapter 8 of this document and NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*. These alarms should be in accordance with Table 8-4.4.

NOTE: In all cases standard "Danger" signs, identifying the purpose of the lights/audible alarms and warning against entry when there is an alarm condition are to be posted as near as practical to the warning devices.

Table 8-4.4 Recommended Ventilation/Gas Alarm for Areas Indicated in 8-4.4

Location	Sounding Devices and Supervision
1. Entrance(s) to such spaces[1]	Visual & Audible Alarm or Equal
2. Within such spaces	Visual & Audible Alarm
3. Local (Within Treatment Plant or Building)	Visual & Audible Alarm
4. Remote (For Distant Stations)[1]	Visual & Audible Alarm

[1] Where stations or areas are unmanned or not constantly attended, the use of a nonaudible signal is permissible if a dual light system or equal is used. A dual light system would include a "go," "no go," or green light, red light type of warning system instead of the audible alarm.
In appropriate situations and where this is impractical, a telephone dialer would be considered to meet the intent of this portion of the table.

8-4.5 Signaling systems should conform to the requirements for supervised signaling systems as set forth in NFPA 71 or NFPA 72.

Chapter 9 Flammable Gas and Vapor Detection

9-1 General. Throughout this chapter, "vapor" will be used to represent collectively gases and vapors. While the words are not synonymous, only vapor is used for convenience. "Fumes" is commonly used in the same context, which is incorrect because fumes are a condensed vaporized metal.

9-2 Selection and Installation.

9-2.1 There are various types of sensing devices, and it is important to select the proper type for each type of vapor. Most organic and inorganic compounds can be safely monitored with a catalytic combustion type sensor. However, organic/metallic solvents containing lead, silicones, plasticizers, or halogens can poison the catalytic element.

9-2.2 The selection and placement of a vapor detection system should be done by a qualified consultant. Installation of a vapor detection system should be done under the direction and supervision of a qualified manufacturer's technical representative to the specified requirements. An improperly designed system may be more dangerous than no system at all because reliance is placed on a system that may not provide adequate protection.

9-2.3 Electric detection equipment located in hazardous (classified) locations, as defined in NFPA 70, *National Electrical Code*, should be listed for use in such atmospheres. To the extent possible, electrical equipment should be located outside of the hazardous locations.

9-3 Placement.

9-3.1 Other types of detectors, such as heat and smoke, have standards recommending spacing usually based on certain area per detector. There are no recognized standards or guidelines for the locating or spacing of vapor detectors. The logic in locating vapor detectors is based on past experience, common sense, and good judgment to a great extent. However, as a minimum, combustible gas detection equipment should be installed in raw wastewater wet wells, digester control buildings, and other areas where combustible gases may be present.

9-3.2 Whether natural or mechanical, air movement is a very important consideration in installing vapor detectors. This aspect must be carefully investigated including effect of doors, windows, vents, and other openings. It may be necessary to conduct a ventilation study that could involve a nontoxic smoke movement analysis.

9-3.3 Dispersion characteristics can also affect detector placement. Vapors will disperse inversely proportional to their specific density in a quiescent environment. Vapors with densities less than air will diffuse quickly at first until the vapor becomes diluted. Heavier-than-air vapors will tend to settle at a low area and not diffuse into the atmosphere unless dispersed by ventilation or temperature currents. Vapors with densities close to that of air will exhibit little mixing effect and will be largely transported by air currents.

9-4 Maintenance.

9-4.1 Once a detection system is installed, a preventive maintenance program is essential. A detection system is only as good as the care and maintenance it receives. This is especially true in harsh environments. When installing instruments, ease of calibration and maintenance should be considered. Periodic calibration, checks, and adjustments are necessary for detection to remain accurate. If instruments are inaccessible it is more likely maintenance procedures will not be followed. Detectors should be located so as not to be exposed to physical damage from normal activities in the area.

9-4.2 Consideration should be given to the scope and limitations of the listing for combustible gas or vapor detectors. For example, Underwriter's Laboratories Inc., in its *Hazardous Location Equipment Directory*, offers some guidance in maintaining and using combustible gas or vapor detectors. The following is extracted from that Directory's product category guide information for listed gas or vapor detectors (JTPX):

> "Gas or vapor detectors should be calibrated and inspected by the operator in compliance with the manufacturer's instructions, as performance of the instruments will depend on proper maintenance. The instruments should be calibrated with known gas- or vapor-air mixtures at intervals and particularly after replaceable sensors incorporated in the detecting unit are replaced. Certain gases or vapors may adversely affect (poison) the sensors and limit the use of the instruments. Sampling atmospheres containing gases or vapors for which they have not been previously calibrated should, therefore, be avoided."

Chapter 10 Administrative Controls

10-1 General.

10-1.1 This chapter establishes recommended practice for the development of administrative procedures and controls necessary for the execution of the fire prevention and fire protection activities and practices for wastewater interceptor systems, pumping stations, and treatment plants.

10-1.2 The administrative controls recommended in this chapter should be reviewed and updated periodically.

10-1.3 The intent of this chapter can be met by incorporating the features of this chapter in the plant's operating procedures or otherwise as determined by plant management.

10-2 Management Policy and Direction.

10-2.1 Management should establish a policy and institute a program to promote conservation of property and continuity of operations as well as provisions for safety to life by adequate fire prevention and fire protection measures at each facility.

10-2.1.1 Proper preventive maintenance of operating equipment as well as adequate operator training are important aspects of a viable fire prevention program.

10-2.1.2 Special management attention should be directed to storage areas for toxic or reactive chemicals. Storage of combustible materials in these areas is not recommended.

10-3 Fire Risk Evaluation.

10-3.1 A fire risk evaluation should be initiated as early in the design process as practical to integrate the fire prevention and fire protection recommendations as described in this document into the plant-specific considerations regarding design, layout, and anticipated operating requirements. The evaluation should result in a list of recommended fire prevention features to be provided based on acceptable means for separation or control of common and special hazards, the control or elimination of ignition sources, and the suppression of fires.

10-3.2 Particular attention should be given during design to consider materials of construction in ventilation systems and in processes that normally operate in a wet condition (examples: plastic media trickling filters, bio-towers, and rotating biological contactors). These systems and process units may represent a considerable fuel load should ignition occur during operation, maintenance, or repair. The design process should consider flammability, flame spread, and smoke production in selection of materials.

10-3.3 Consideration should be given during the design process to locating process areas (examples: screen rooms, areas containing gas management equipment, etc.) that represent significant explosion hazard remote from other process areas to reduce the risk of consequent damage should an explosion occur.

10-4* Fire Prevention Program. A written plant fire prevention program should be established and as a minimum should include the following:

(a) Firesafety information for all employees and contractors. This information should include, as a minimum, familiarization with fire protection procedures, plant emergency alarms and procedures, and how to report a fire.

(b) Documented plant inspections including provisions for handling remedial actions to correct conditions that increase fire hazards.

(c) A description of the general housekeeping practices and the control of transient combustibles, including control of such materials stored in areas containing toxic or reactive chemicals.

(d) Control of flammable and combustible liquids and gases in accordance with appropriate NFPA standards.

(e) Control of ignition sources to include smoking, grinding, welding, and cutting. (*See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*)

(f) Fire prevention surveillance. (*See NFPA 601, Standard on Guard Service in Fire Loss Prevention.*)

(g) Fire report, including an investigation and a statement on the corrective action to be taken.

10-5 Testing, Inspection, and Maintenance.

10-5.1 Upon installation, all fire protection systems should be preoperationally inspected and tested in accordance with applicable NFPA standards. Where appropriate standards do not exist, inspection and test procedures outlined in the purchase and design specifications should be followed.

10-5.2 All fire protection systems and equipment should be periodically inspected, tested, and maintained.

10-5.2.1 Table 10-1 is provided for guidance.

10-5.3 Testing, inspection, and maintenance should be documented with written procedures, results, and follow-up actions recorded.

10-6 Impairments.

10-6.1 A written procedure should be established to address impairments to fire protection systems and other plant systems that have an impact on the level of fire hazard (dust collection systems, HVAC systems, etc.). As a minimum, this procedure should include the following:

(a) Identify equipment not available for service.

(b) Identify personnel to be notified (plant fire brigade chief, public fire department, etc.).

(c) Increase fire surveillance as needed. [*See 10-4(g).*]

10-6.2 Impairment to fire protection systems should be as short in duration as practical. If the impairment is planned, all necessary parts and manpower should be assembled prior to removing the protection system(s) from service. When an impairment is not planned, the repair work should be expedited until the repairs are completed.

10-6.3 Once repairs are complete, tests that will confirm proper operation and restoration of full fire protection equipment capabilities should be made. Following restoration to service, the parties previously notified of the impairment should be advised.

10-7 Fire Emergency Plan. A written fire emergency plan should be developed and, as a minimum, this plan should include the following:

(a) Response to fire alarms and fire systems' supervisory alarms.

(b) Notification of personnel identified in the plan.

(c) Evacuation of employees not directly involved in fire fighting activities from the fire area.

(d) Coordination with security forces or other designated personnel to admit public fire department and control traffic and personnel.

(e) Fire extinguishment activities.

(f) Periodic drills to verify viability of the plan.

(g) In critical areas, operators' activities during fire emergencies. Approved breathing apparatus should be readily available in critical areas.

10-8 Fire Brigade.

10-8.1 The size of the plant and its staff, the complexity of fire fighting problems, and the availability of a public fire department should determine the requirements for a fire brigade. The organization of a fire brigade is encouraged for wastewater treatment facilities located in remote areas.

10-8.2 If a fire brigade is provided, its organization and training should be identified in written procedures.

NOTE: Recommendations contained in NFPA 600, *Standard on Industrial Fire Brigades*, and OSHA 1910.156 should be consulted for additional information.

10-8.3 The following items discuss special fire fighting conditions unique to wastewater facilities. This information might be useful in fire brigade training and fire preplanning.

(a) Cable tray fires should be handled like any fire involving energized electrical equipment. It may not be practical or desirable to deenergize the cables involved in the fire. Water is the most effective extinguishing agent for

Table 10-1 Fire Equipment Inspection, Testing, and Maintenance Frequency Schedule

Item	Weekly	Monthly	Semiannually	Annually	NFPA No.
Supervisory Alarm Circuits	X	T			71/72/72H/26
Fire and Smoke Detectors		A	M/T		71/72E/72H
Flammable Gas and Vapor Detectors	X		M/T		—
Manual Fire Alarms		A	M/T		71/72H
Sprinkler Water Flow Alarms		M/T			13A/71/72H
Sprinkler and Water Spray Systems	X	A	M	T[1,2]	15/13A
Foam Systems	X	A	M	T[1,2]	11/11A/16
Halogenated Agent, Chemical and CO_2 Systems	X	A	M	T[1,2]	12/12A/17/12B
Fire Pumps and Booster Pumps	T[3]	H		T[4]	20
Water Tanks and Alarms	X	A	M/T		13A/71
Post Indicator Valves and Outside Stem and Yoke Valves (P.I.V.s) and O.S.&Y. Valves	X[5]	X[5]	M/T		13A/26/72H
Fire Hydrants and Associated Valves		X		M/T	13A/24/26
Fire Hose and Standpipes		X		T[6]	14/1962
Portable Fire Extinguishers and Hose Nozzles		X[7]		X	10/1962
Fire Brigade Equipment				T	1972
Fire Doors	X	T			80
Smoke Vents/Ventilation Systems		X		M/T	204M
Emergency Lighting		X/T			70
Flame Arrestors/ Flame Checks			M/T		—
Radio Communication Equipment		T			—
Standby Power	(in accordance with manufacturer's recommendations)				

Code: X = Inspection/Calibration
T = Operational Test
M = Maintenance
A = Alarm Test (Transmitters)

NOTES:

1. Testing of these systems should be done where possible after necessary precautions have been taken to eliminate any hazardous conditions that would result from the discharge of the extinguishing agent.
2. On systems where flow testing is not practical, a representative number of nozzles should be removed and checked for signs of blockage. In these cases the annual test will consist of a trip test of deluge/preaction valves or valve operators as applicable.
3. This is a test to verify pump operability only.
4. Performance tests to be conducted under load to verify that the pumps meet design conditions.
5. Valves not locked to be inspected weekly. Valves locked or electrically supervised to be inspected monthly.
6. Testing of standpipes to include waterflow at highest elevations.
7. Inspection and testing of emergency breathing apparatus in with current OSHA/NIOSH rules and regulations.

cable insulation fires, but must be applied with an electrically safe nozzle. Some cables [polyvinyl chloride (PVC), neoprene, or Hypalon] can produce dense smoke in a very short time. In addition, PVC liberates hydrogen chloride (HCl) gas. Self-contained breathing apparatus should be used by personnel attempting to extinguish cable tray fires.

(b) Some sludge drying and composting processes (especially solvent extraction drying, sludge drying kilns, and in-vessel composting systems) may produce a product that may be subject to spontaneous combustion. Generally, water will be the most effective fire fighting agent in these areas. However, fires may be deep-seated in stockpiled products, which may have to be dispersed with front end loaders or similar equipment to fully extinguish smouldering and burning material.

(c) Some chlorinated hydrocarbon products commonly used as foam suppressants or flocculation agents in wastewater treatment may cause spontaneous combustion when in contact with powdered disinfectants. These chemicals should be stored separately, and care should be used in their use.

(d) Plastic or fiberglass-reinforced plastic materials used in process units or ventilation systems may represent a considerable fuel load if ignited during operation or maintenance and may require special response techniques.

10-9 Coordination with Local Fire Officials. Management is encouraged to meet with local fire officials to familiarize fire department staffs with the peculiarities of each installation. Contingency and response plans should be developed for potential fire and explosion hazard emergencies.

10-10 Polychlorinated Biphenyls. Federal regulations (40 CFR761.30) require that the local fire department be notified of the location of all polychlorinated biphenyls (PCBs) filled transformers and other electrical equipment. The wastewater facility owner, in cooperation with local fire officials, should prepare a contingency plan to protect the plant and the collection system from possible contamination should PCBs or combustion products be leaked or washed into the drains during fire events.

Chapter 11 Referenced Publications

11-1 The following documents or portions thereof are referenced within this recommended practice and should be considered part of the recommendations of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

11-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1, *Fire Prevention Code*, 1987 edition

NFPA 10, *Standard for Portable Fire Extinguishers*, 1990 edition

NFPA 11, *Standard for Low Expansion Foam and Combined Agent Systems*, 1988 edition

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1988 edition

NFPA 11C, *Standard for Mobile Foam Apparatus*, 1990 edition

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 1989 edition

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 1989 edition

NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems*, 1990 edition

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1991 edition

NFPA 13A, *Recommended Practice for the Inspection, Testing and Maintenance of Sprinkler Systems*, 1987 edition

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1990 edition

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 1990 edition

NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*, 1991 edition

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 1990 edition

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, 1990 edition

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 1987 edition

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1992 edition

NFPA 26, *Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection*, 1988 edition

NFPA 30, *Flammable and Combustible Liquids Code*, 1990 edition

NFPA 31, *Standard for the Installation of Oil Burning Equipment*, 1987 edition

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 1990 edition

NFPA 43A, *Code for the Storage of Liquid and Solid Oxidizers*, 1990 edition

NFPA 43C, *Code for the Storage of Gaseous Oxidizing Materials*, 1986 edition

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 1991 edition

NFPA 49, *Hazardous Chemicals Data*, 1991 edition

NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites*, 1990 edition

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 1992 edition

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1989 edition

NFPA 53M, *Manual on Fire Hazards in Oxygen-Enriched Atmospheres*, 1990 edition

NFPA 54, *National Fuel Gas Code*, 1988 edition

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, 1992 edition

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 1990 edition

NFPA 61A, *Standard for the Prevention of Fire and Dust Explosions in Facilities Manufacturing and Handling Starch*, 1989 edition

NFPA 68, *Guide for Venting of Deflagrations*, 1988 edition

NFPA 69, *Standard on Explosion Prevention Systems*, 1992 edition

NFPA 70, *National Electrical Code*, 1990 edition

NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, 1990 edition

NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*, 1988 edition

NFPA 71, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*, 1989 edition

NFPA 72, *Standard for the Installation, Maintenance, and Use of Protective Signaling Systems*, 1990 edition

NFPA 72E, *Standard on Automatic Fire Detectors*, 1990 edition

NFPA 72H, *Guide for Testing Procedures for Local, Auxiliary, Remote Station, and Propriety Protective Signaling Systems*, 1988 edition

NFPA 77, *Recommended Practice on Static Electricity*, 1988 edition

NFPA 78, *Lightning Protection Code*, 1989 edition

NFPA 80, *Standard for Fire Doors and Windows*, 1990 edition

NFPA 82, *Standard on Incinerators, Waste, and Linen Handling Systems and Equipment*, 1990 edition

NFPA 85A, *Standard for the Prevention of Furnace Explosions in Fuel Oil- and Natural Gas-Fired Single Burner Boiler-Furnaces*, 1987 edition

NFPA 85C, *Standard for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces*, 1991 edition

NFPA 85F, *Standard for the Installation and Operation of Pulverized Fuel Systems*, 1988 edition

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, 1989 edition

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, 1992 edition

NFPA *101*, *Life Safety Code*, 1991 edition

NFPA 204M, *Guide for Smoke and Heat Venting*, 1991 edition

NFPA 220, *Standard on Types of Building Construction*, 1992 edition

NFPA 231, *Standard for General Storage*, 1990 edition

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 1989 edition

NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials*, 1990 edition

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, 1990 edition

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 1990 edition

NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*, 1987 edition

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 1987 edition

NFPA 321, *Standard on Basic Classification of Flammable and Combustible Liquids*, 1991 edition

NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers*, 1987 edition

NFPA 328, *Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers, and Similar Underground Structures*, 1987 edition

NFPA 329, *Recommended Practice for Handling Underground Leakage of Flammable and Combustible Liquids*, 1987 edition

NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids on Farms and Isolated Construction Projects*, 1988 edition

NFPA 491M, *Manual of Hazardous Chemical Reactions*, 1991 edition

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 1989 edition

NFPA 497A, *Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 1992 edition

NFPA 513, *Standard for Motor Freight Terminals*, 1990 edition

NFPA 600, *Standard on Industrial Fire Brigades*, 1992 edition

NFPA 601, *Standard on Guard Service in Fire Loss Prevention*, 1992 edition

NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 1989 edition

NFPA 1962, *Standard for the Care, Use, and Maintenance of Fire Hose Including Couplings and Nozzles*, 1988 edition

NFPA 1972, *Standard on Helmets for Structural Fire Fighting*, 1987 edition

NFPA *Industrial Fire Brigade Training Manual*

11-1.2 Other Publications.

11-1.2.1 ANSI Publications. American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI/ISA RP 12.67-1976, *Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations*

ANSI Z210.1-1976, *Standard for Metric Practices*

11-1.2.2 API Publications. American Petroleum Institute, 1220 L St., NW, Washington, DC 20005.

API RP500A-82, *Classification of Locations for Electrical Installations in Petroleum Refineries*

API RP500B-87, *Classification of Areas for Electrical Locations at Drilling Rigs and Production Facilities on Land and on Marine Fixed and Mobile Platforms*

11-1.2.3 ASTM Publications. American Society of Testing and Materials, 1916 Race St., Philadelphia PA 19103.

ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C (1382°F)*

ASTM E814, *Standard Method of Fire Tests of Through-Penetration Fire Stops*

11-1.2.4 Code of Federal Regulations. U.S. Government Printing Office, Washington, DC 20402.

40 CFR761.30

OSHA 1910.156

11-1.2.5 Chlorine Institute Publication. The Chlorine Institute, 342 Madison Avenue, New York, NY 10017.

Properties of Chlorine

11-1.2.6 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

Hazardous Location Equipment Directory

Appendix A

This Appendix is not a part of the recommendations of this NFPA document, but is included for information purposes only.

A-1-3.1 In existing facilities, it is not always practical to strictly apply the provisions of this recommended practice. Physical limitations may require disproportionate effort or expense with little increase in fire protection. In such cases, the authority having jurisdiction must be satisfied that reasonable fire protection is assured.

In existing facilities it is intended that any condition that represents a serious threat to fire protection be mitigated by application of appropriate safeguards. It is not intended to require modification for conditions that do not represent a significant threat to fire protection, even though such conditions are not literally in conformance with these fire protection guidelines.

A-2-1 See Figures A-2-1 through A-2-40.

A-4-1 See Figures A-4-1 through A-4-8.

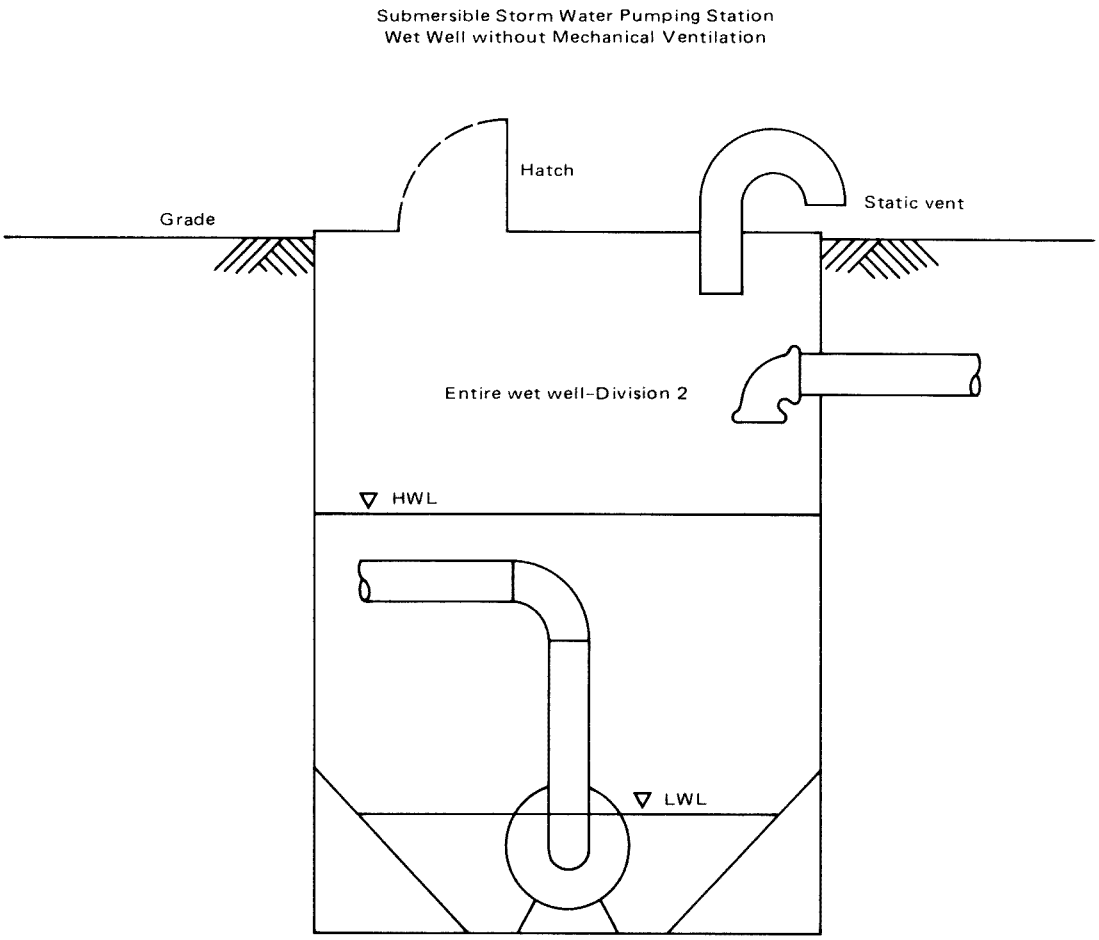

Figure A-2-1 Illustration of Table 2, row 4.

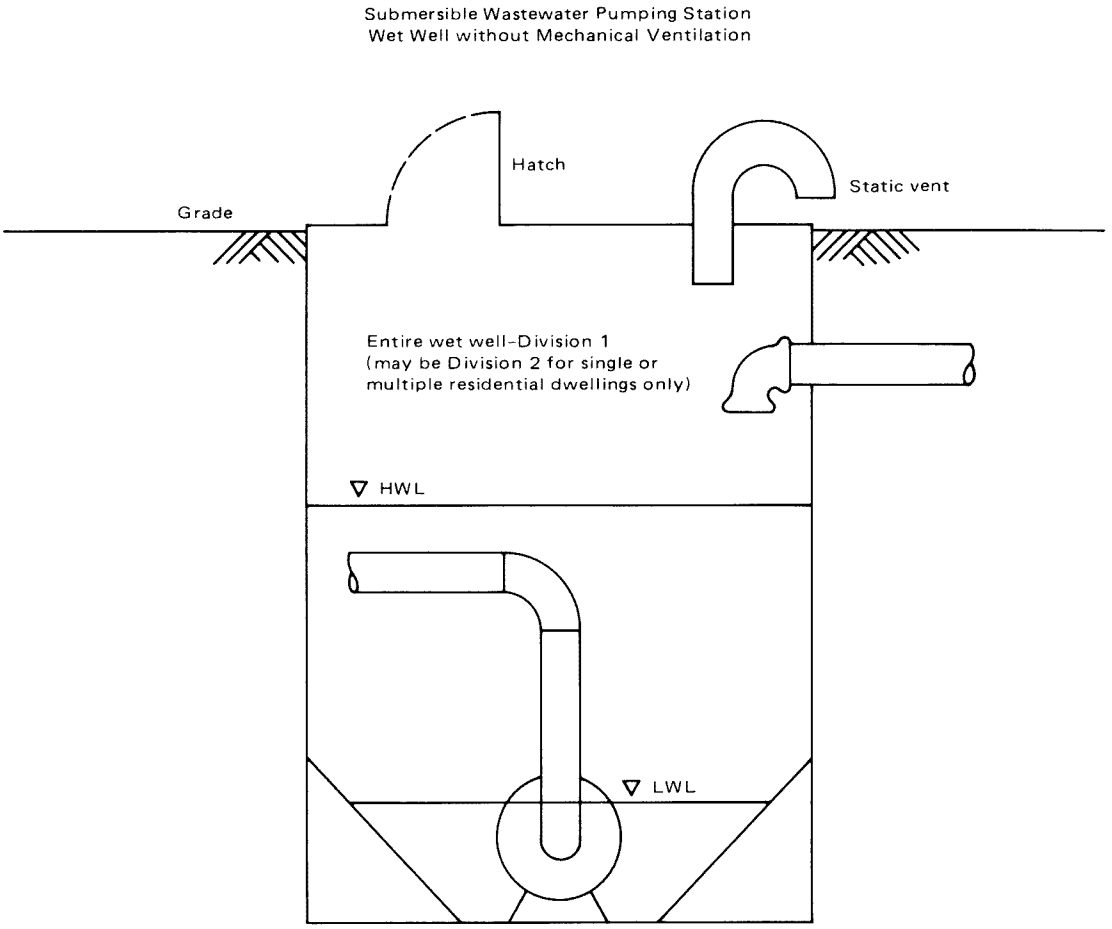

Figure A-2-2 Illustration of Table 2, row 10a.

Submersible Wastewater Pumping Station
Wet Well with Mechanical Ventilation

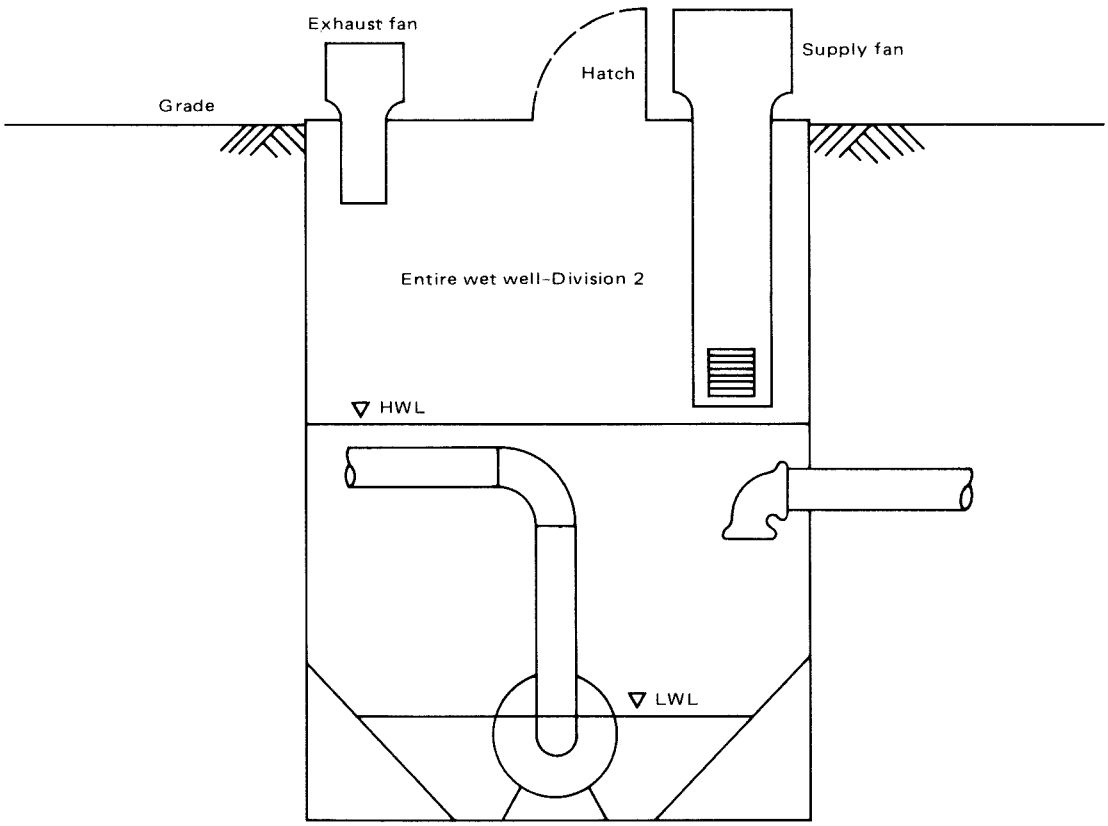

Figure A-2-3 Illustration of Table 2, row 10b.

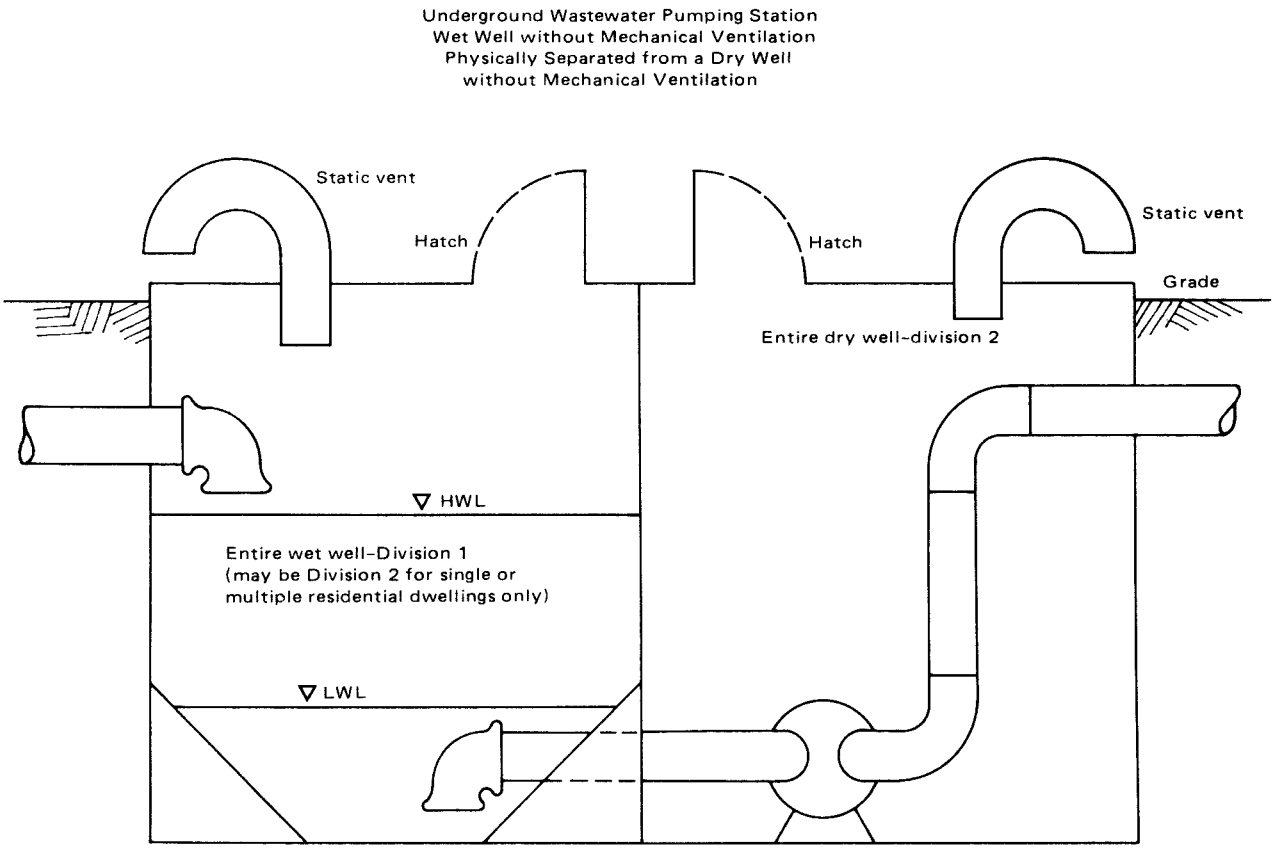

Figure A-2-4 Illustration of Table 2, row 12a.

Underground Wastewater Pumping Station
Wet Well without Mechanical Ventilation,
Physically Separated from a Dry Well
without Mechanical Ventilation

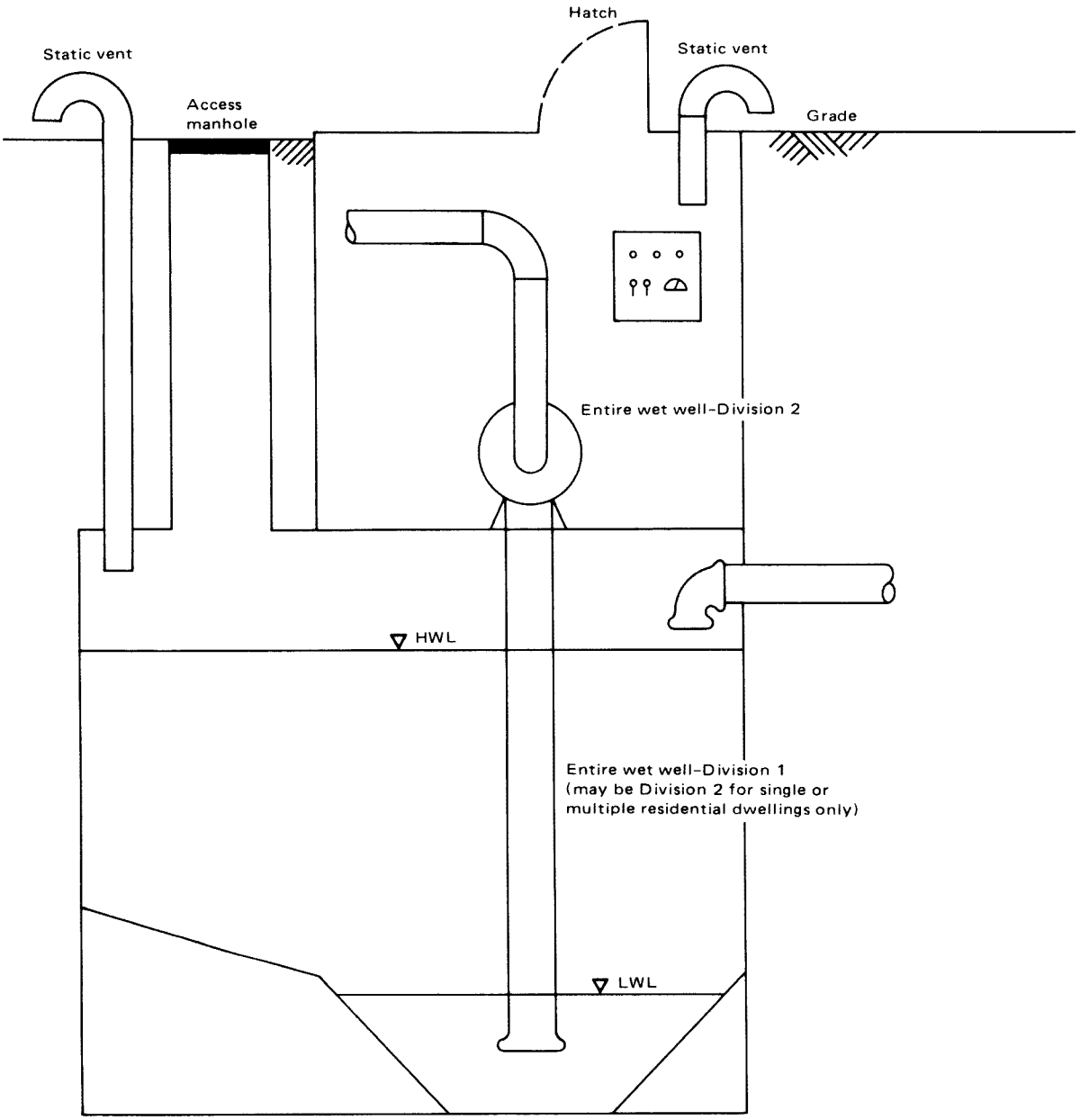

Figure A-2-5 Illustration of Table 2, row 12a.

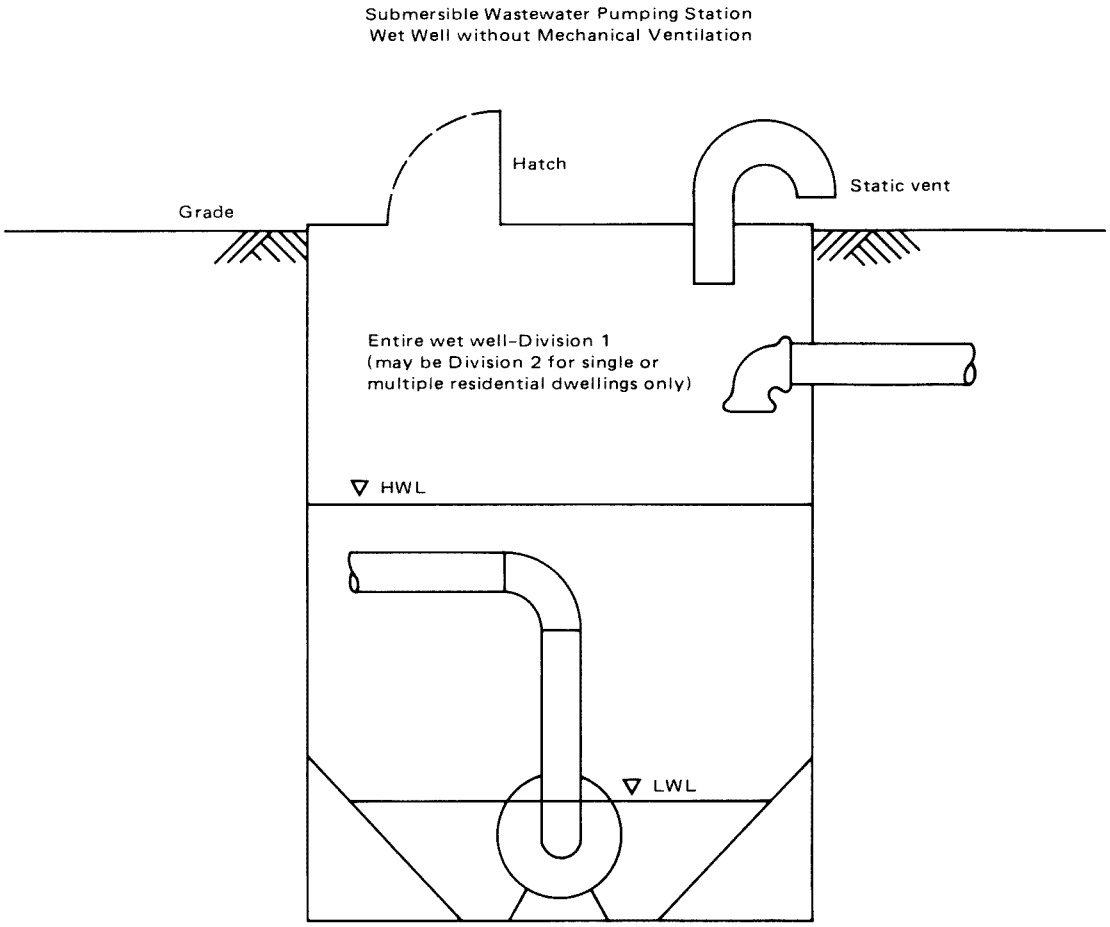

Figure A-2-6 Illustration of Table 2, row 12a.

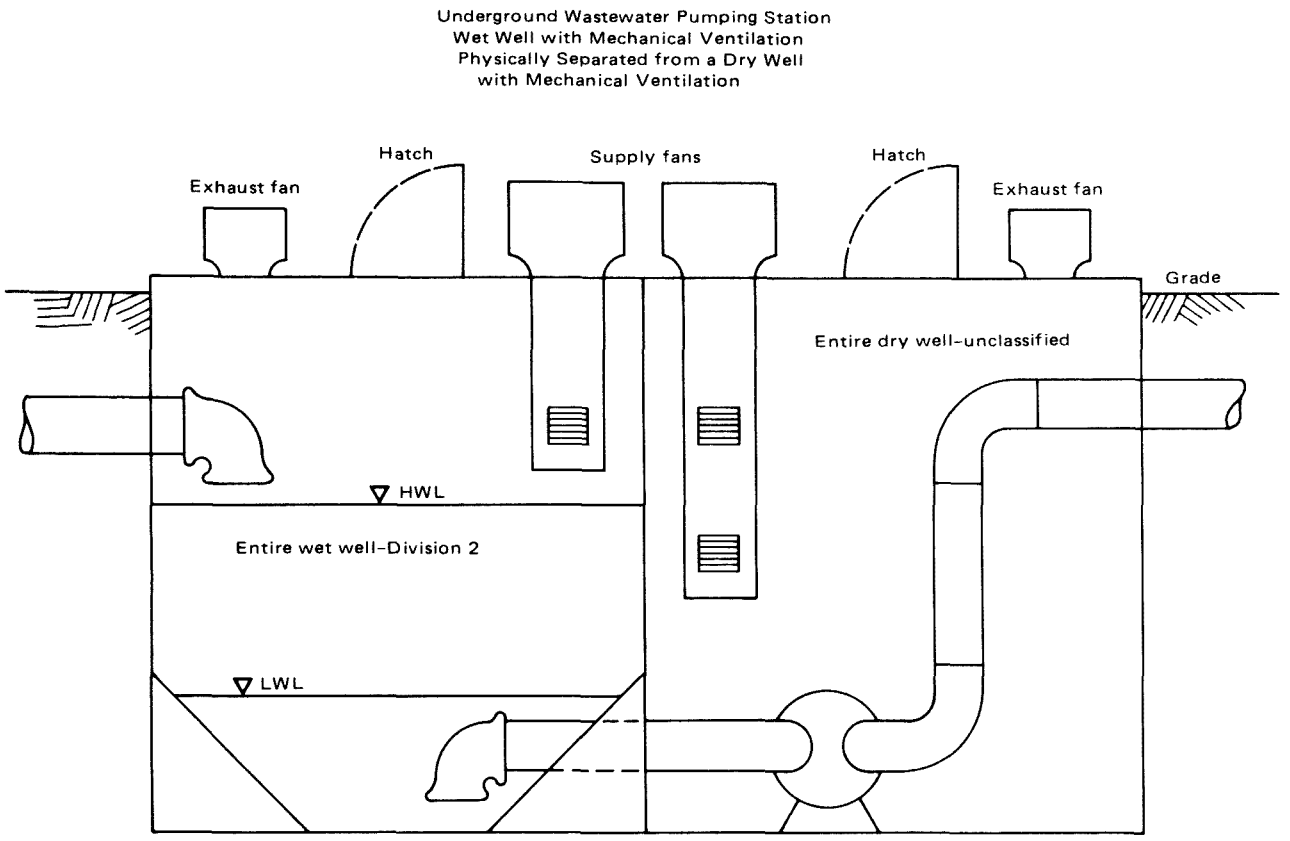

Figure A-2-7 Illustration of Table 2, row 12b.

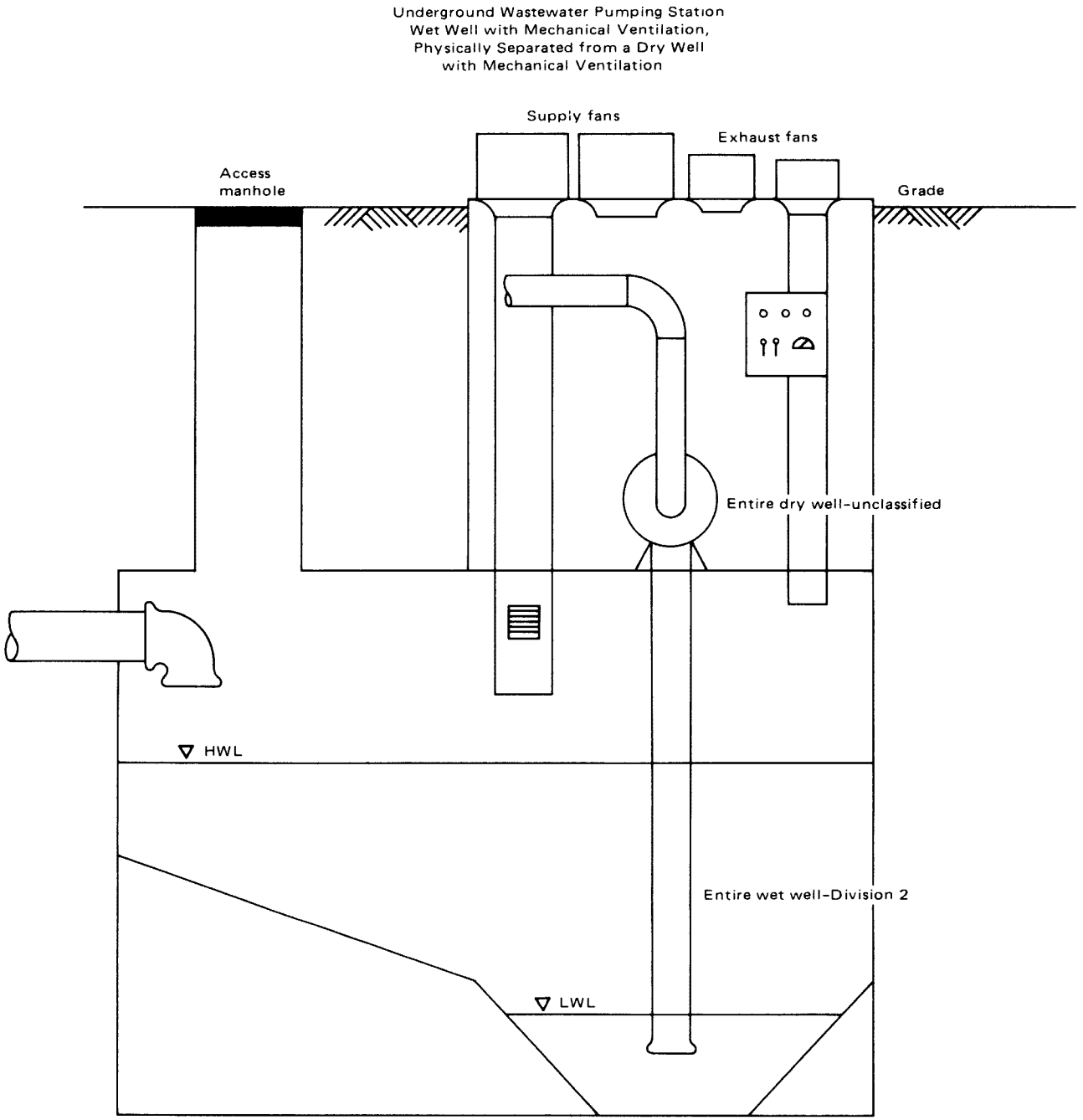

Figure A-2-8 Illustration of Table 2, row 12b.

Submersible Wastewater Pumping Station
Wet Well with Mechanical Ventilation

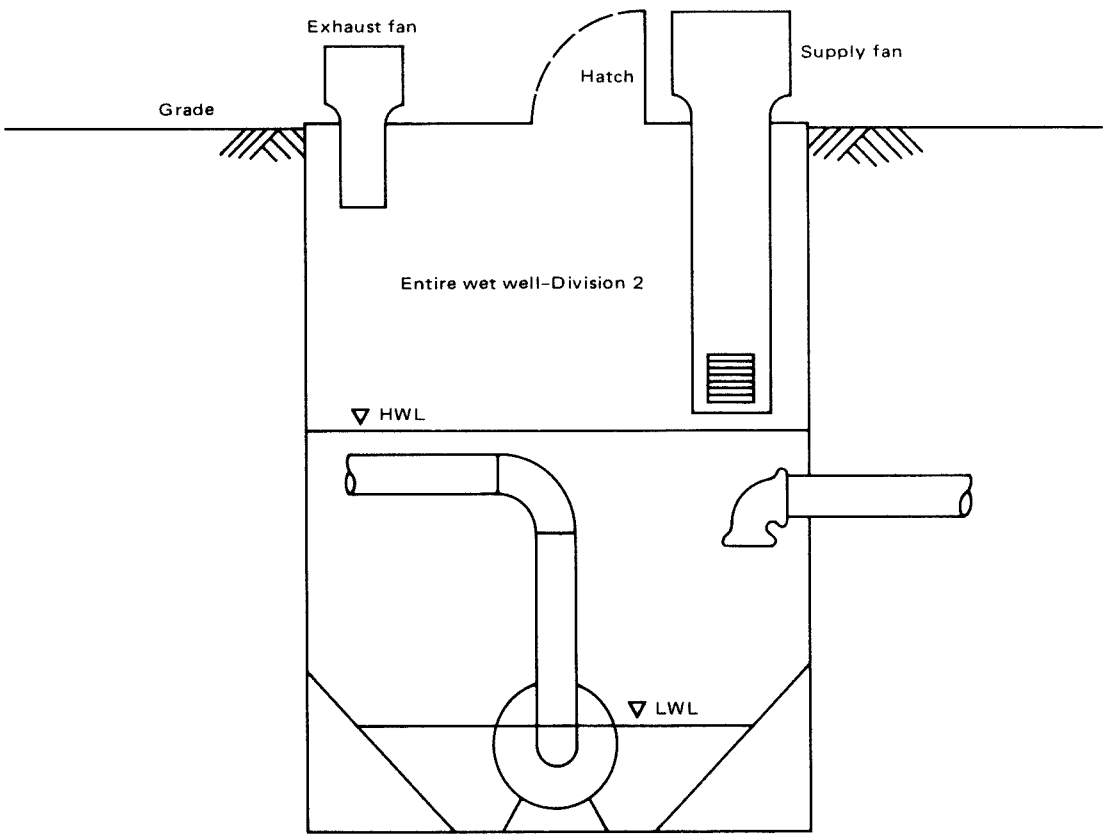

Figure A-2-9 Illustration of Table 2, row 12b.

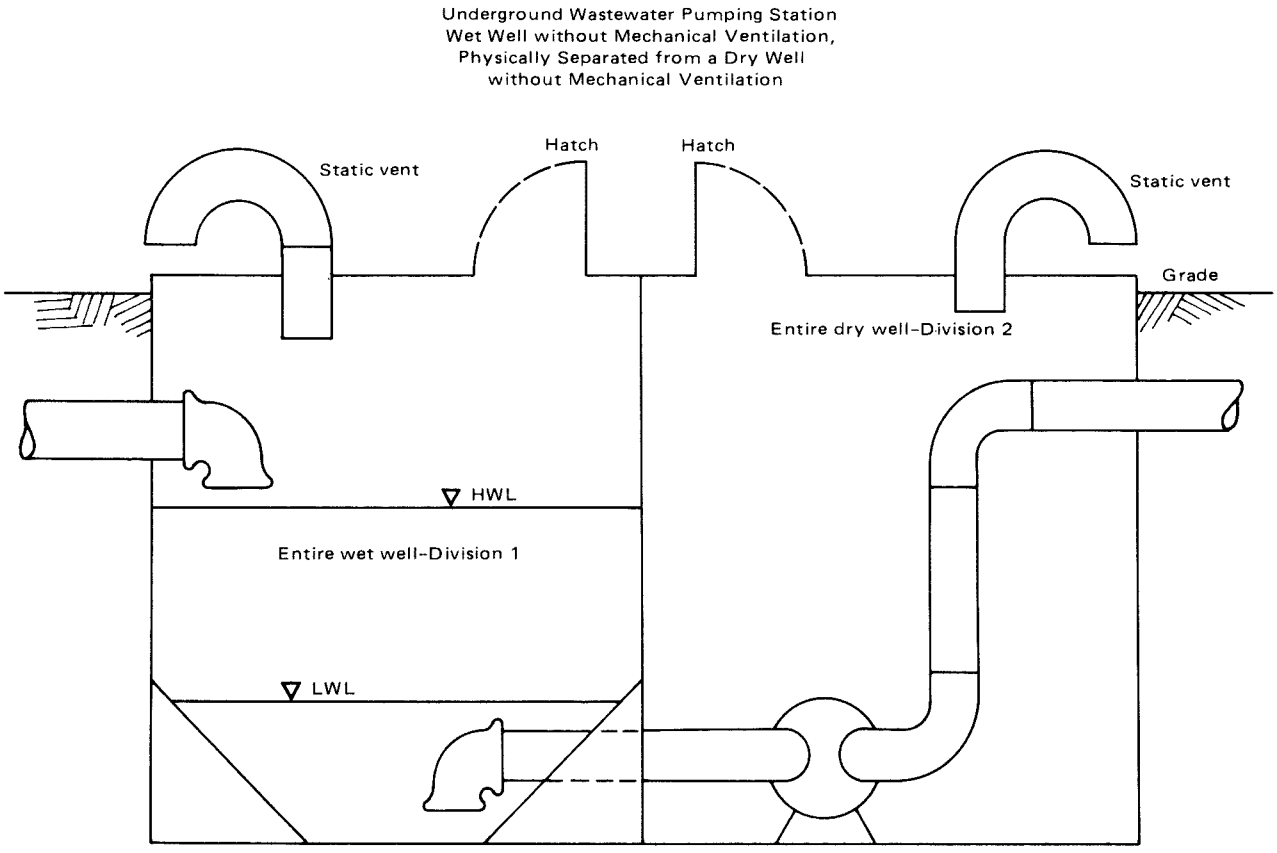

Figure A-2-10 Illustration of Table 2, row 13a.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

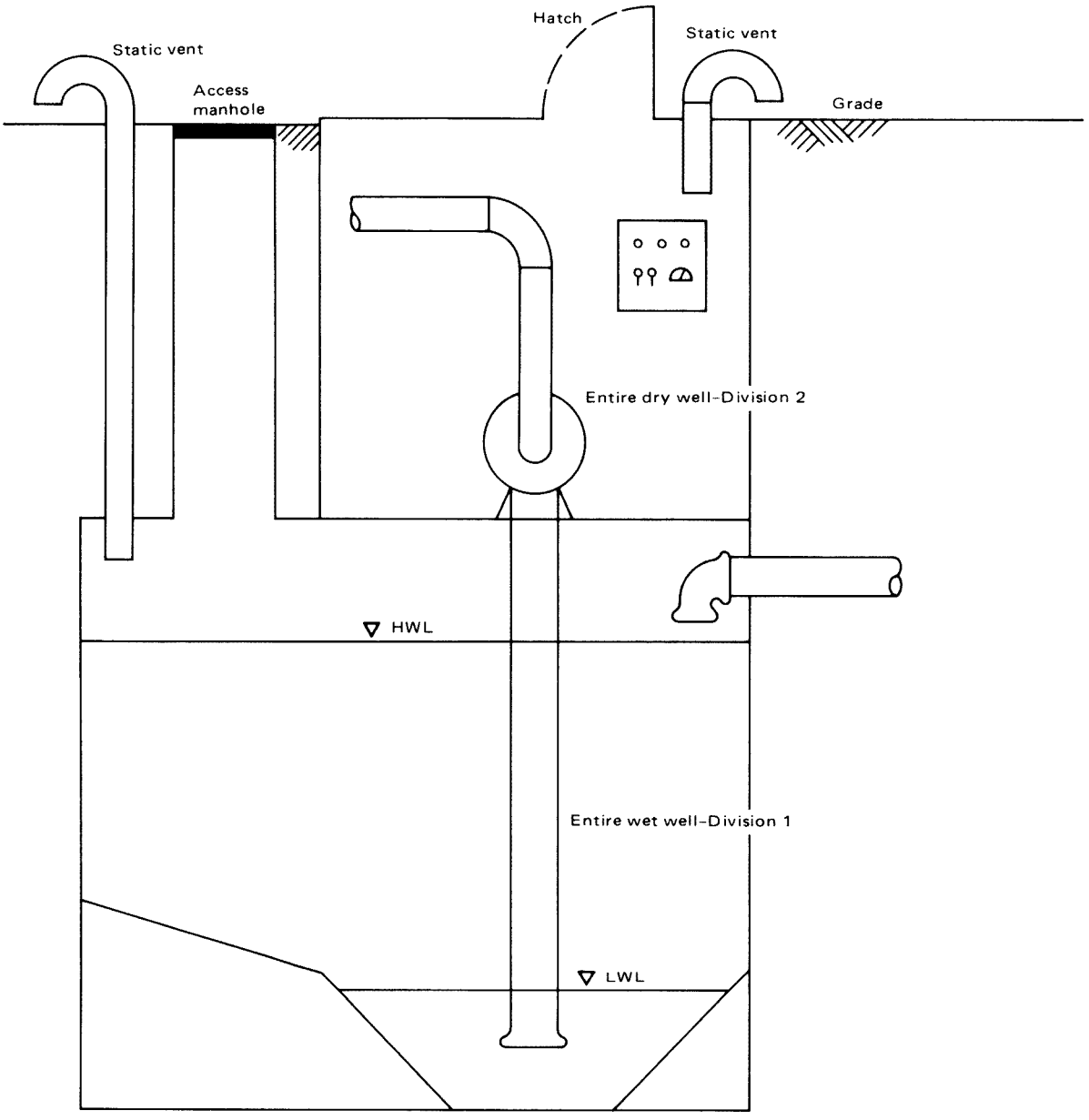

Figure A-2-11 Illustration of Table 2, row 13a.

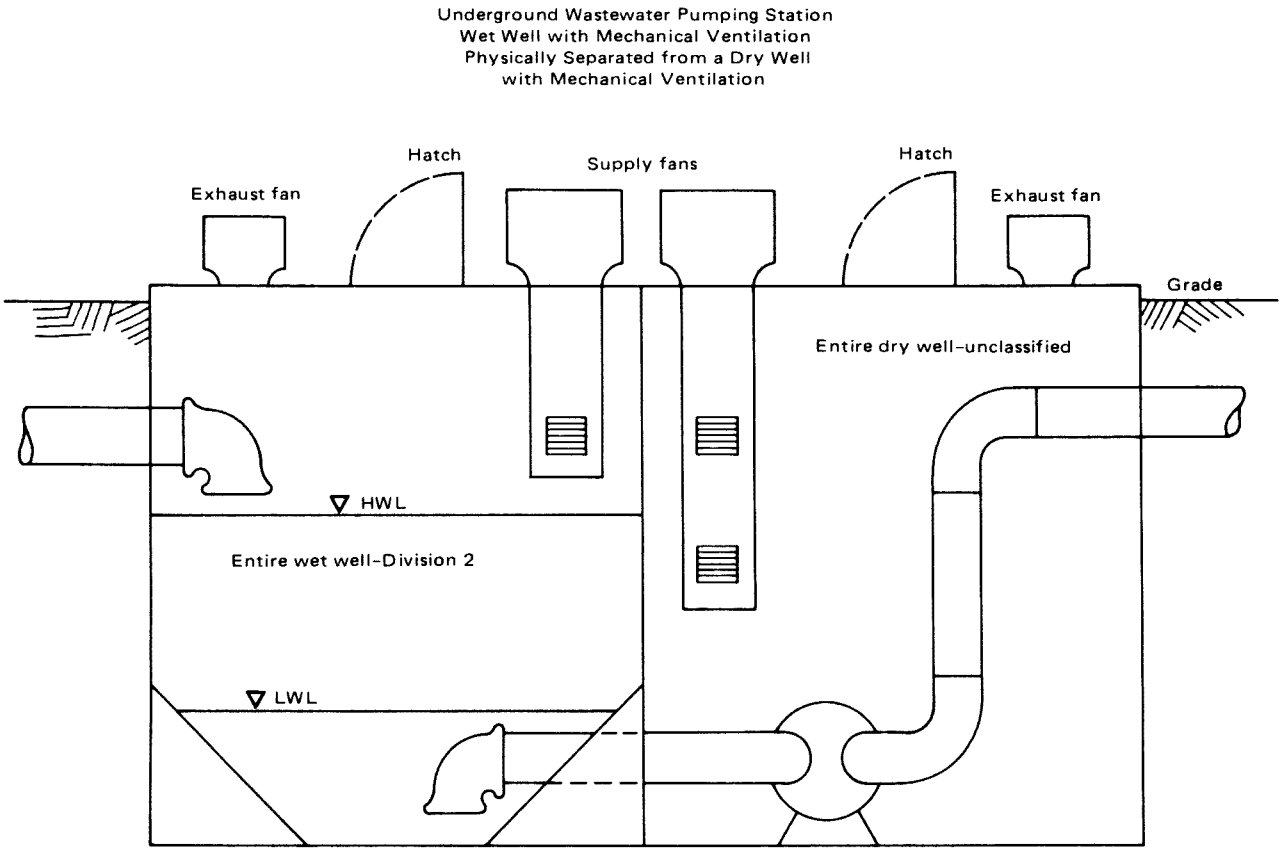

Figure A-2-12 Illustration of Table 2, row 13b.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

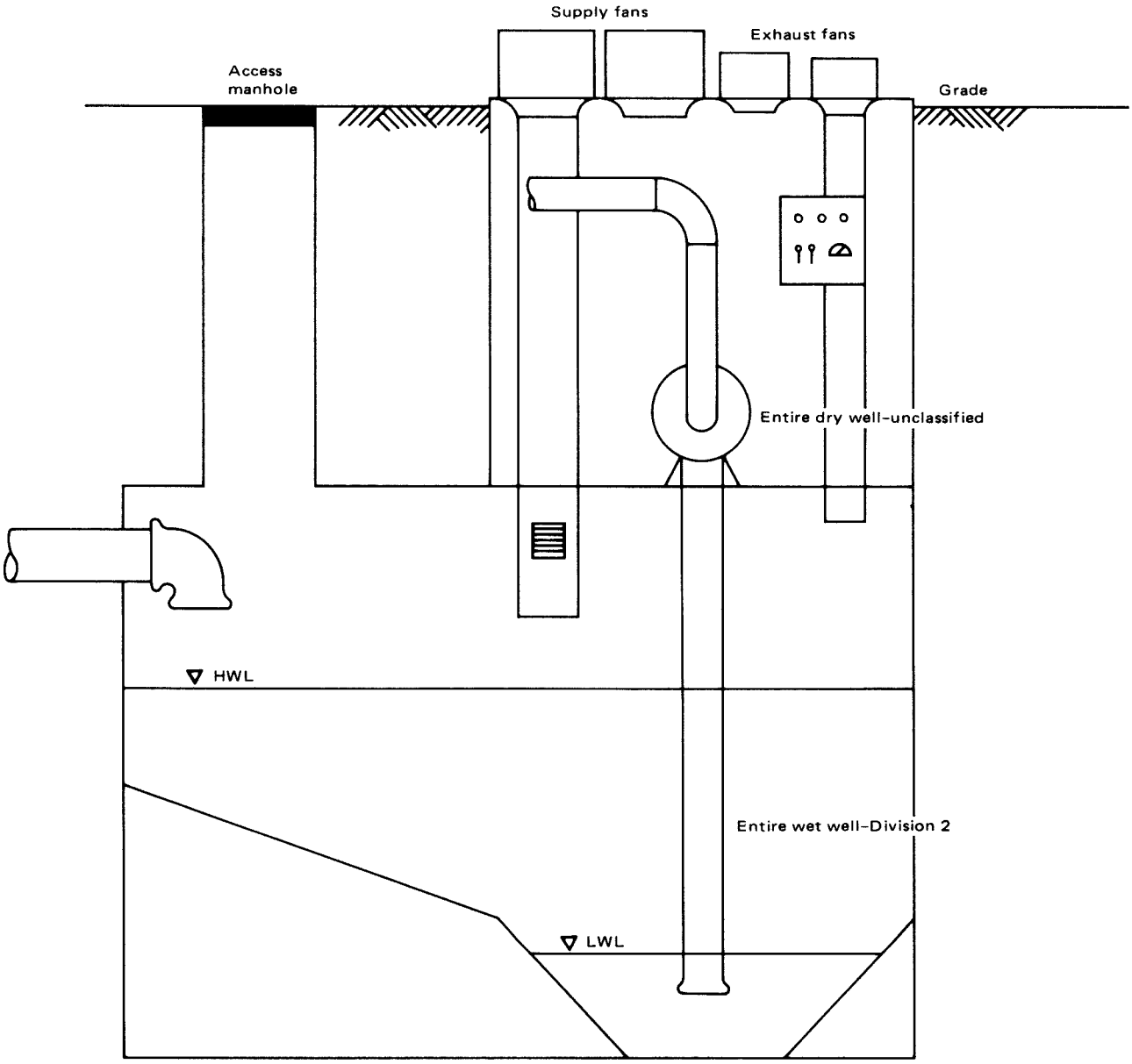

Figure A-2-13 Illustration of Table 2, row 13b.

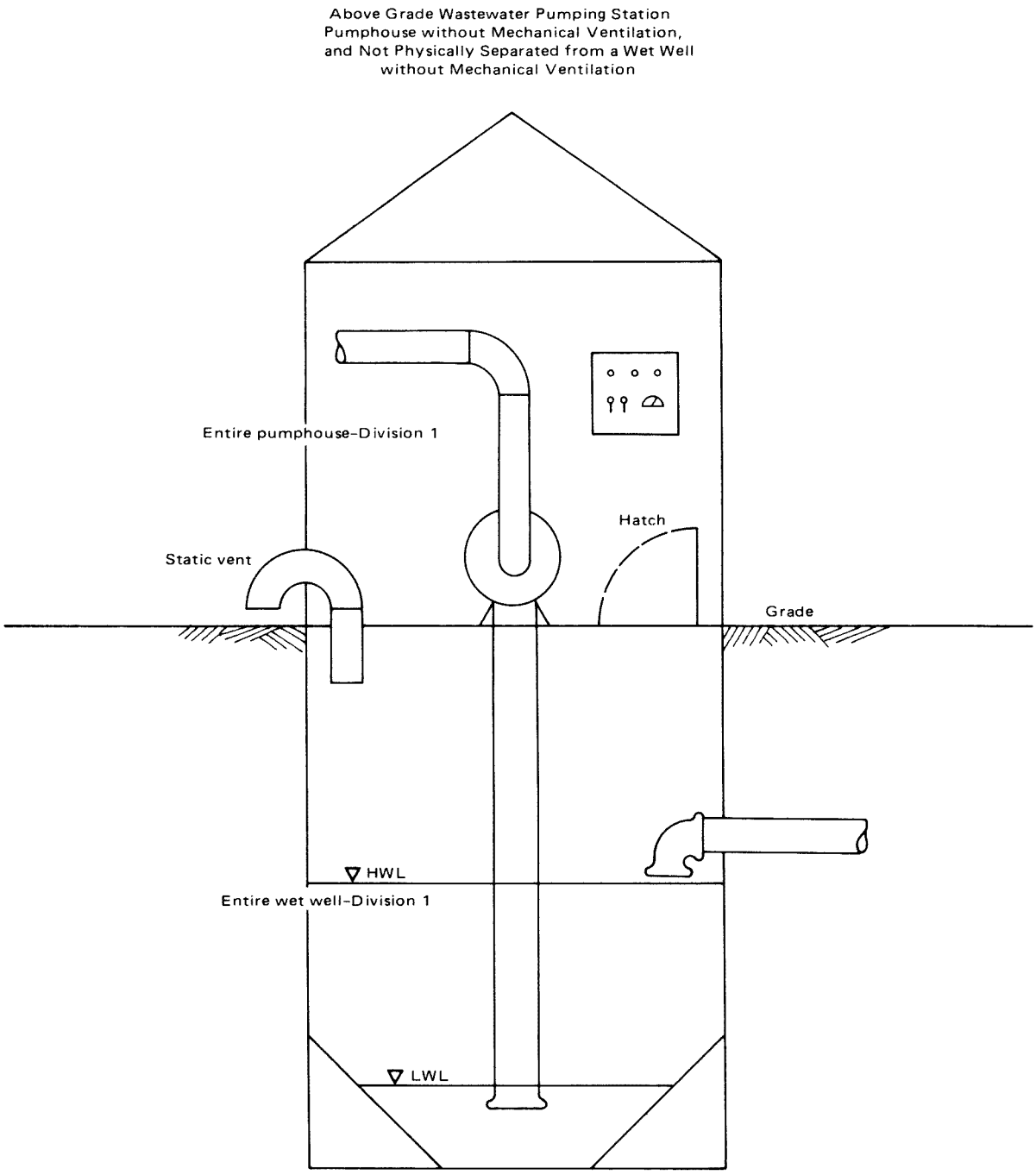

Figure A-2-14 Illustration of Table 2, row 17a.

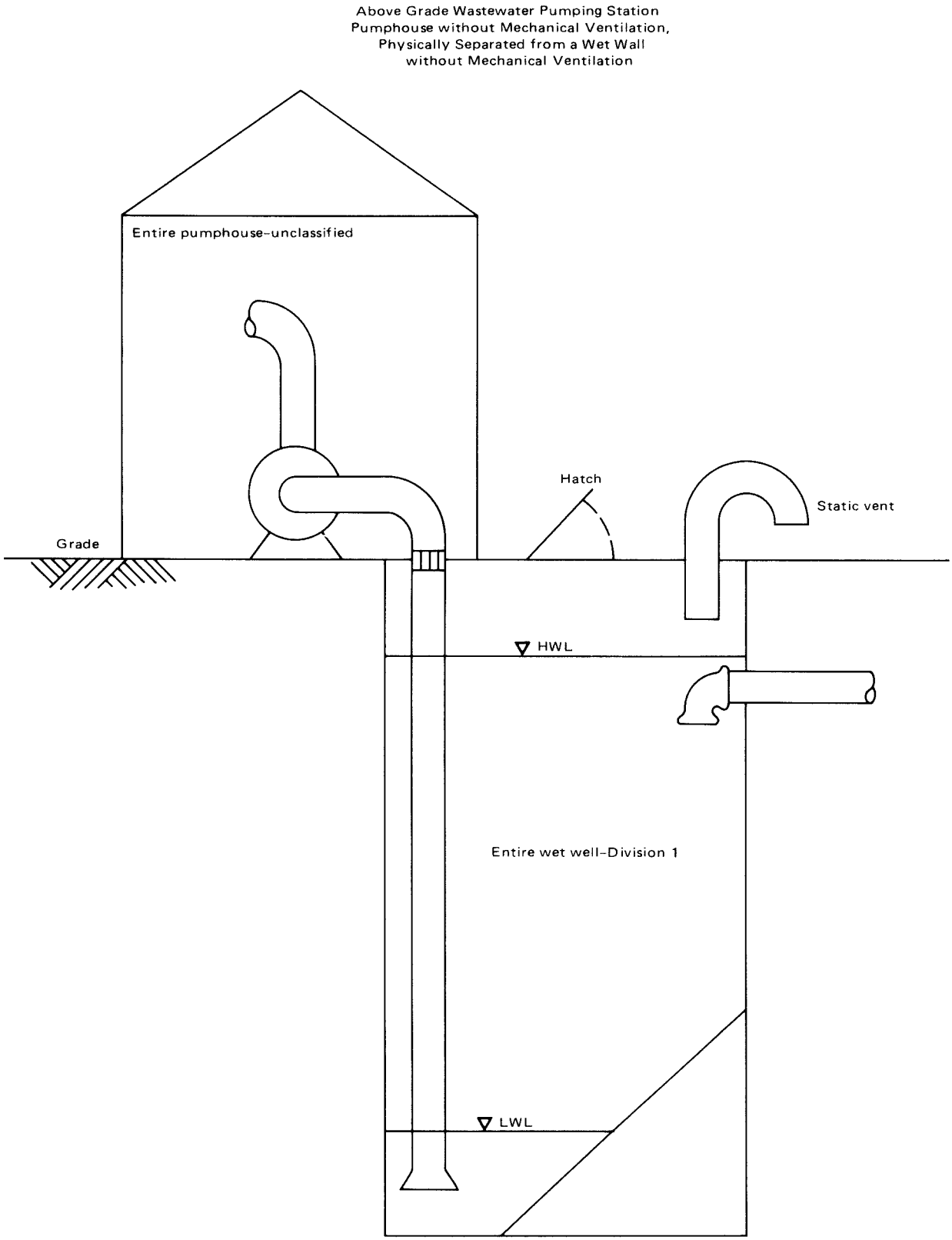

Figure A-2-15 Illustration of Table 2, row 17a.

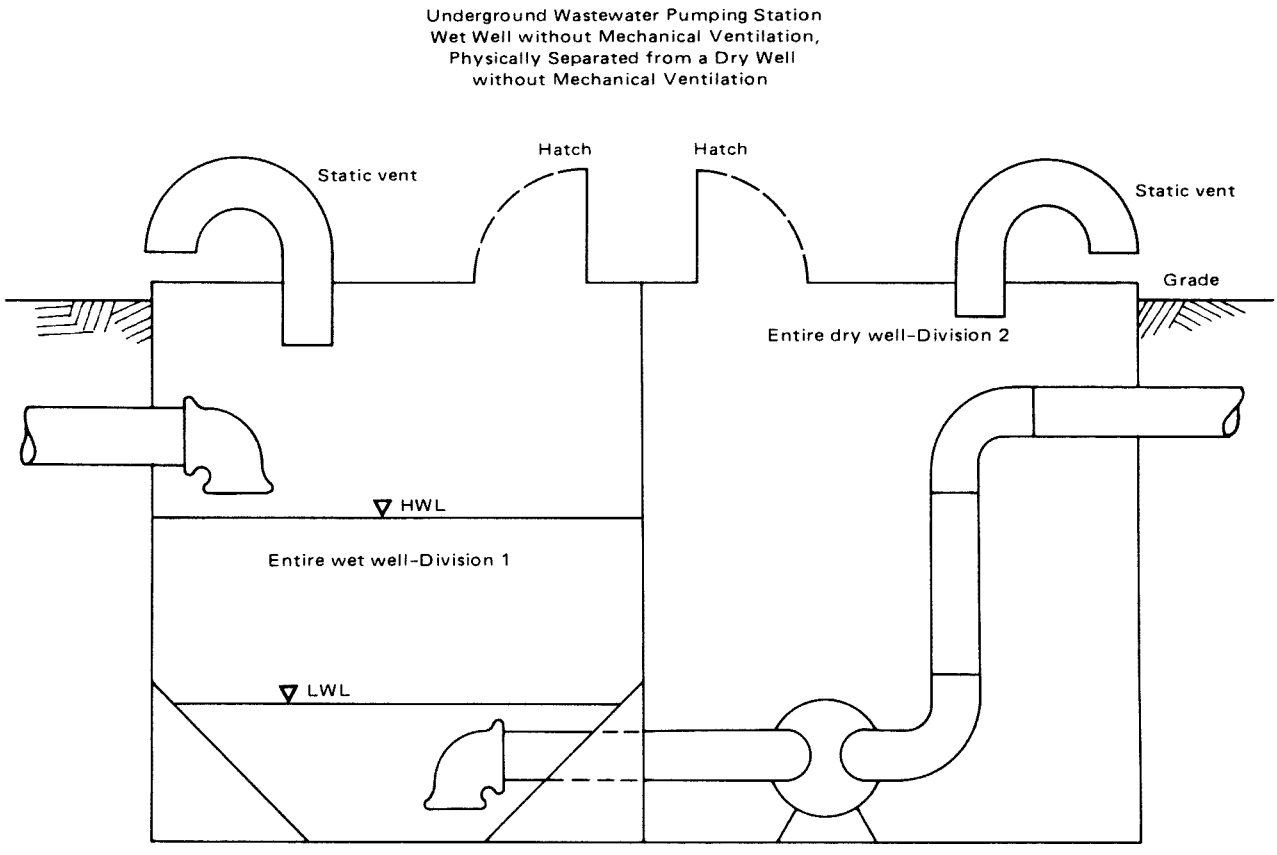

Figure A-2-16 Illustration of Table 2, row 17a.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

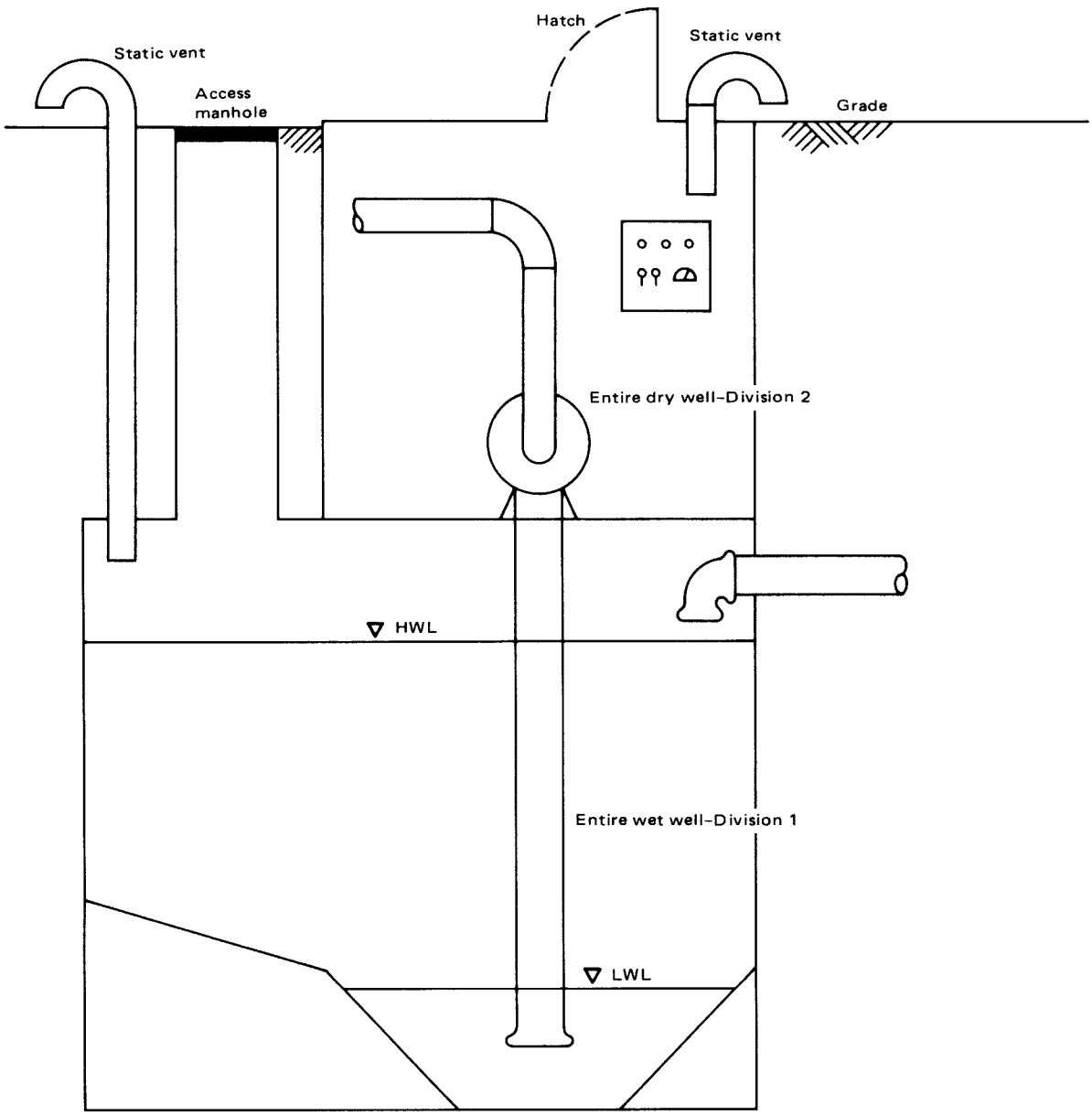

Figure A-2-17 Illustration of Table 2, row 17a.

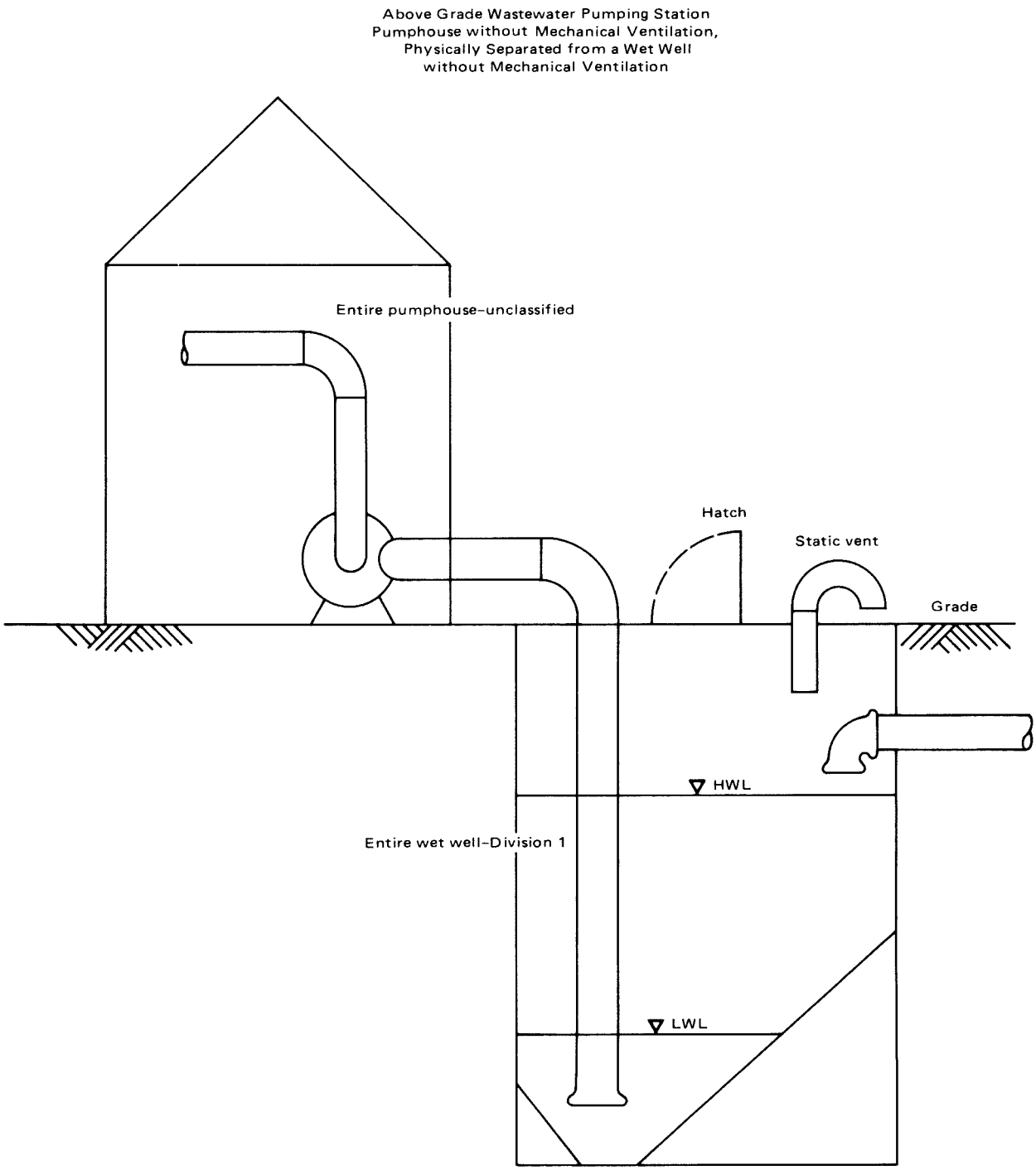

Figure A-2-18 Illustration of Table 2, row 17a.

Above Grade Wastewater Pumping Station
Pumphouse without Mechanical Ventilation
Physically Separated from a Wet Well
without Mechanical Ventilation

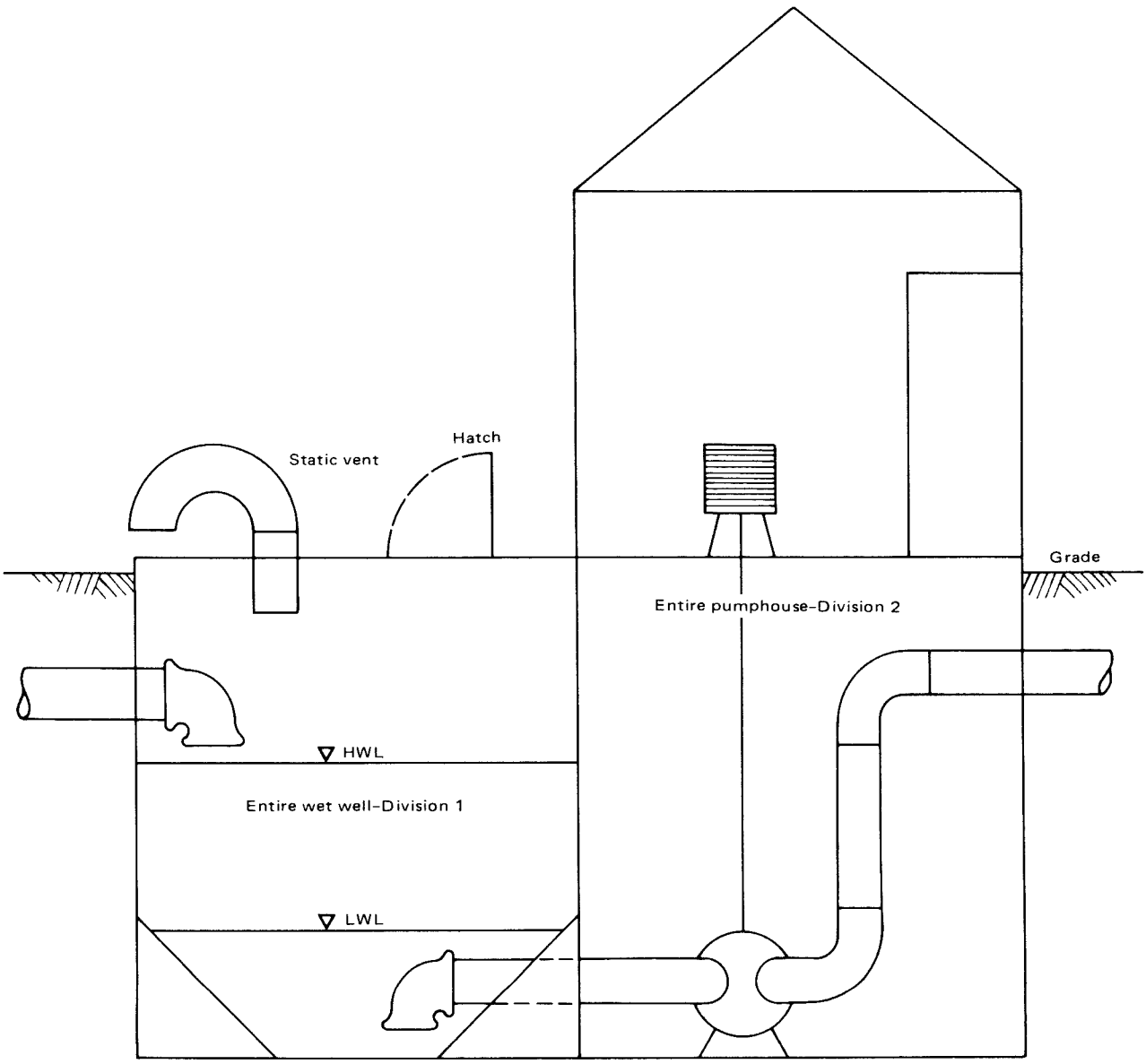

Figure A-2-19 Illustration of Table 2, row 17a.

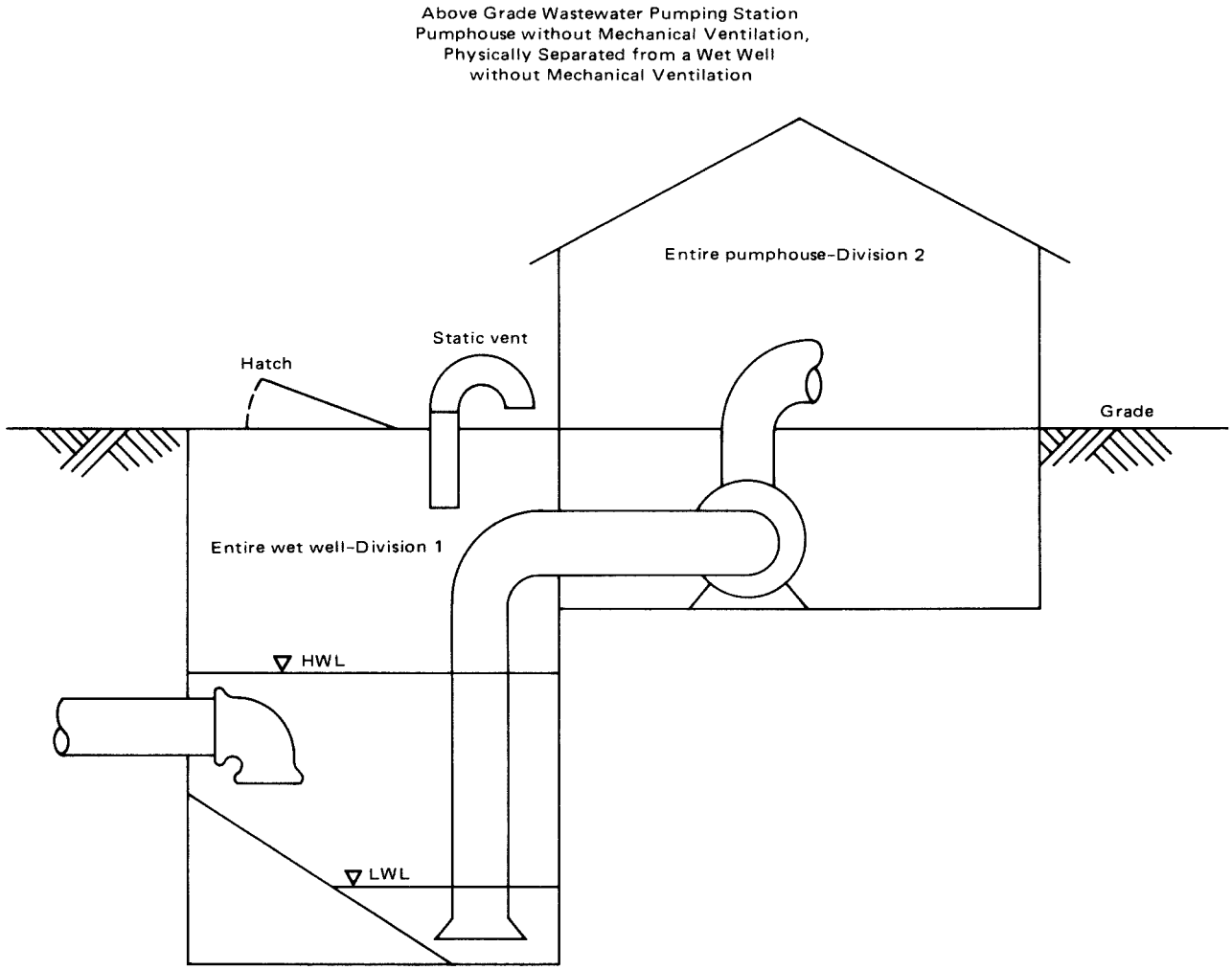

Figure A-2-20 Illustration of Table 2, row 17a.

Above Grade Wastewater Pumping Station
Pumphouse with Mechanical Ventilation
and Physically Separated from a
Wet Well without Mechanical Ventilation

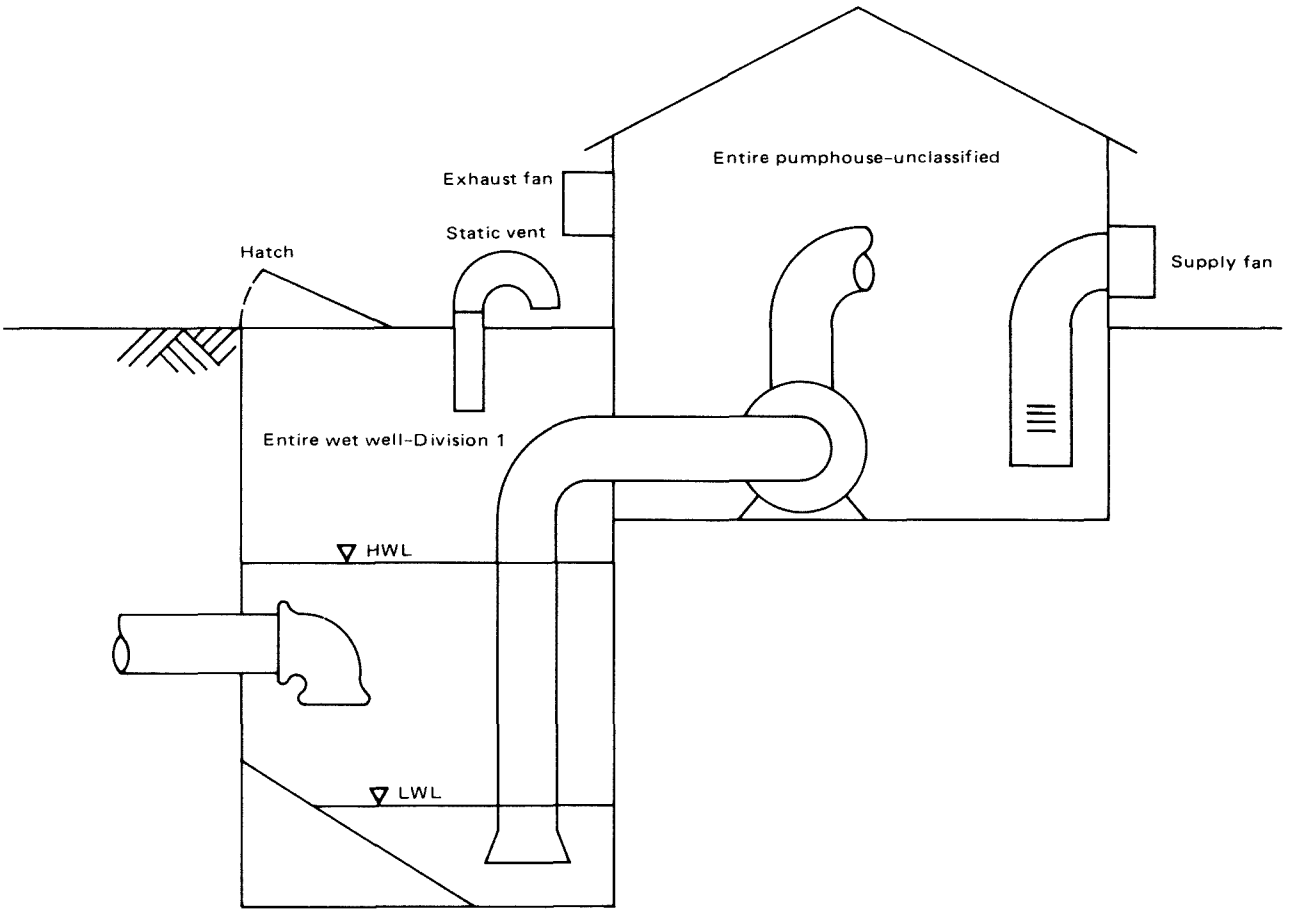

Figure A-2-21 Illustration of Table 2, row 17a.

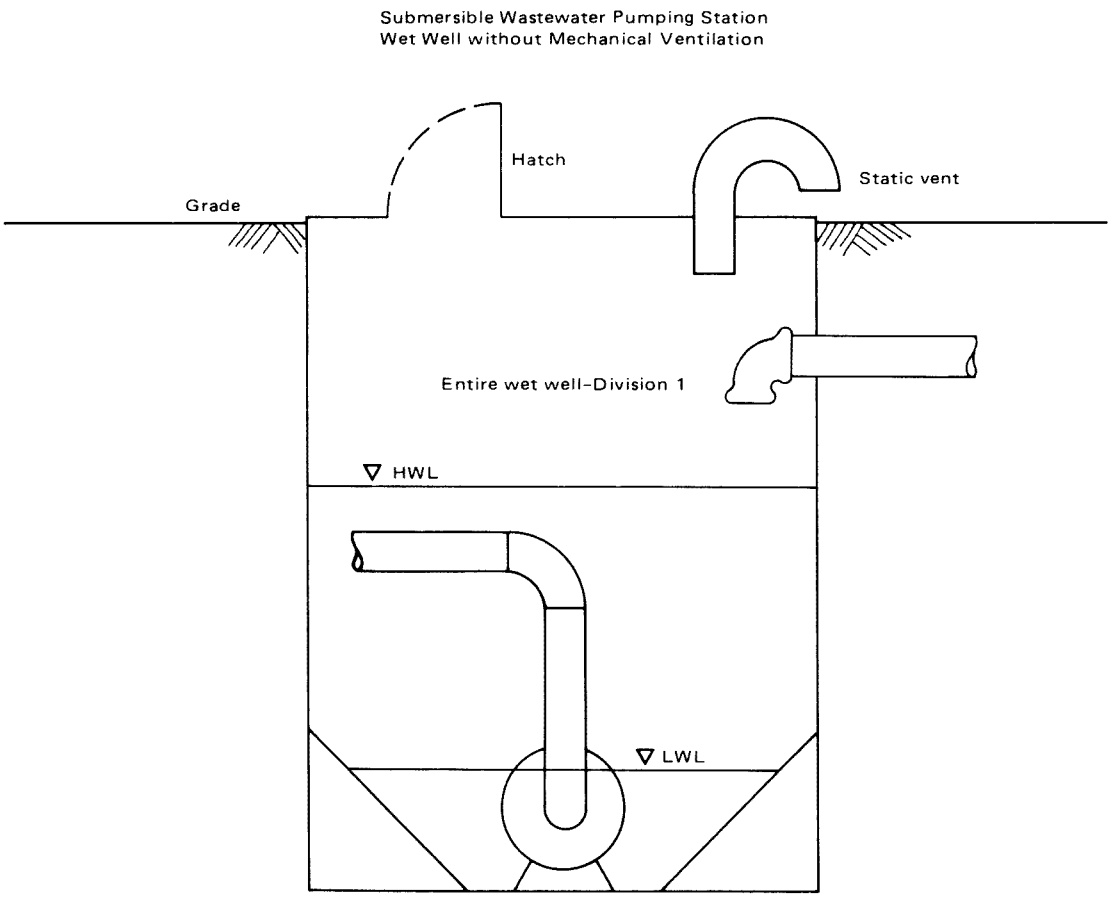

Figure A-2-22 Illustration of Table 2, row 17a.

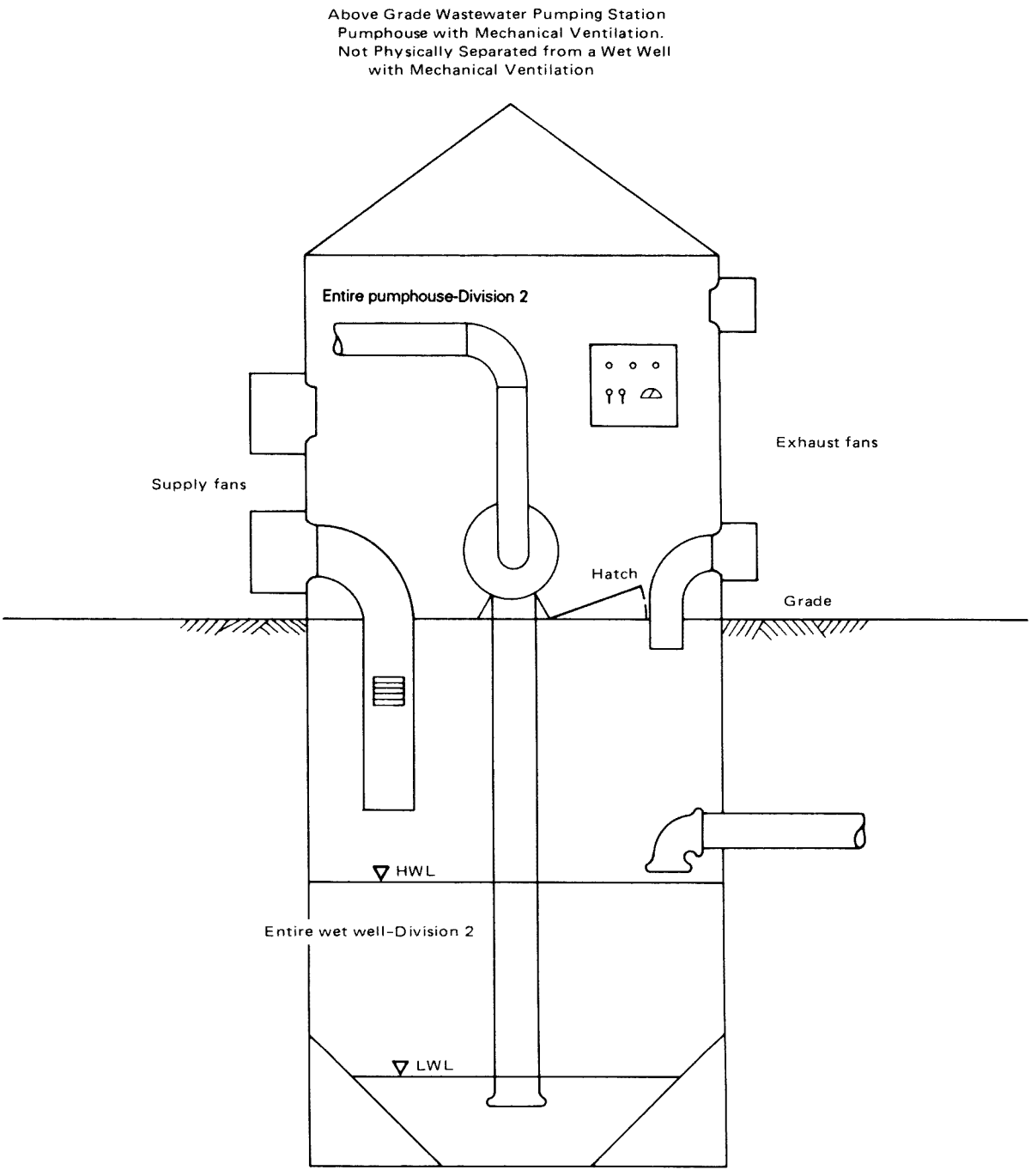

Figure A-2-23 Illustration of Table 2, row 17b.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

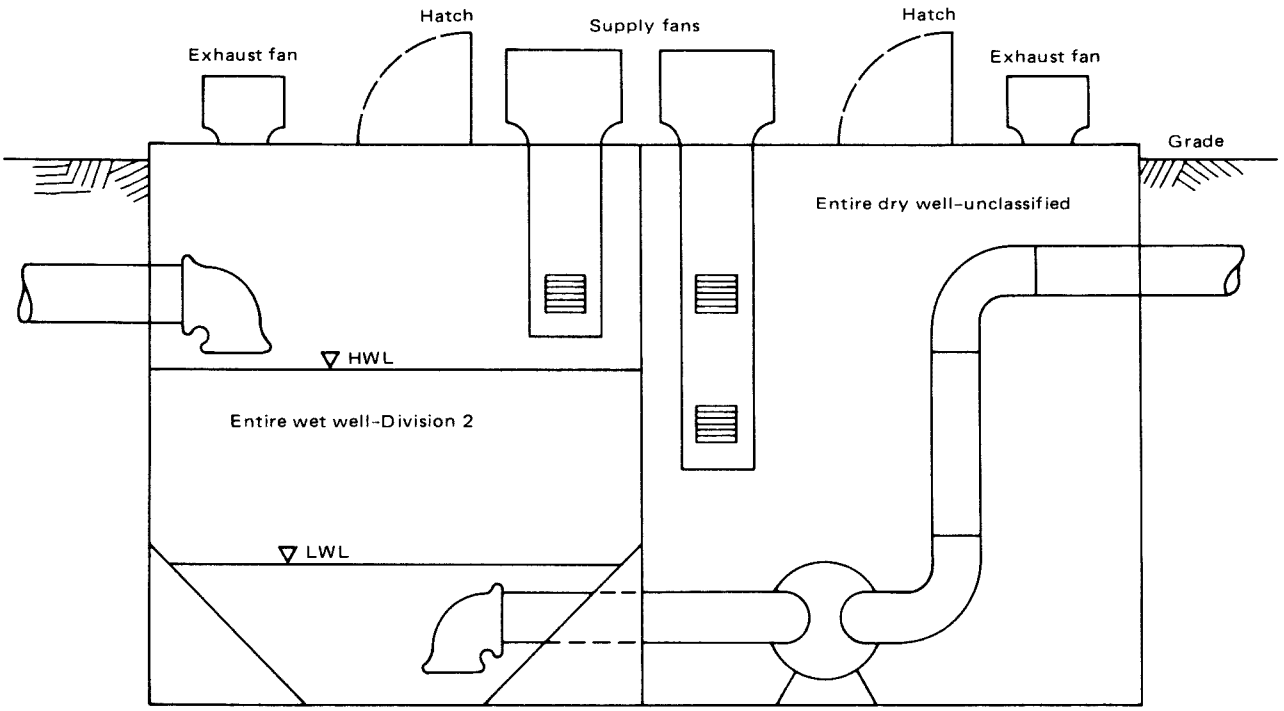

Figure A-2-24 Illustration of Table 2, row 17b.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

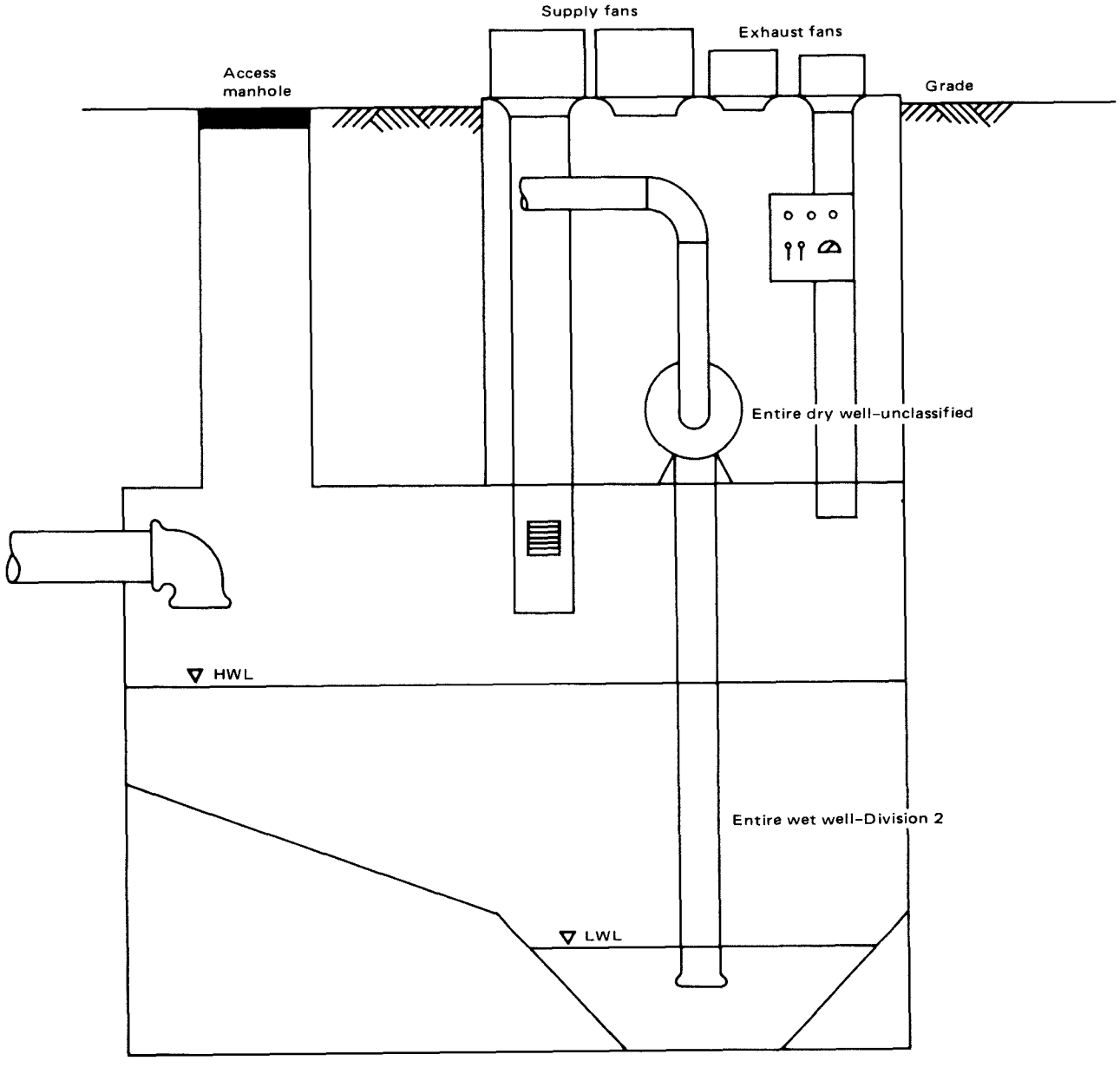

Figure A-2-25 Illustration of Table 2, row 17b.

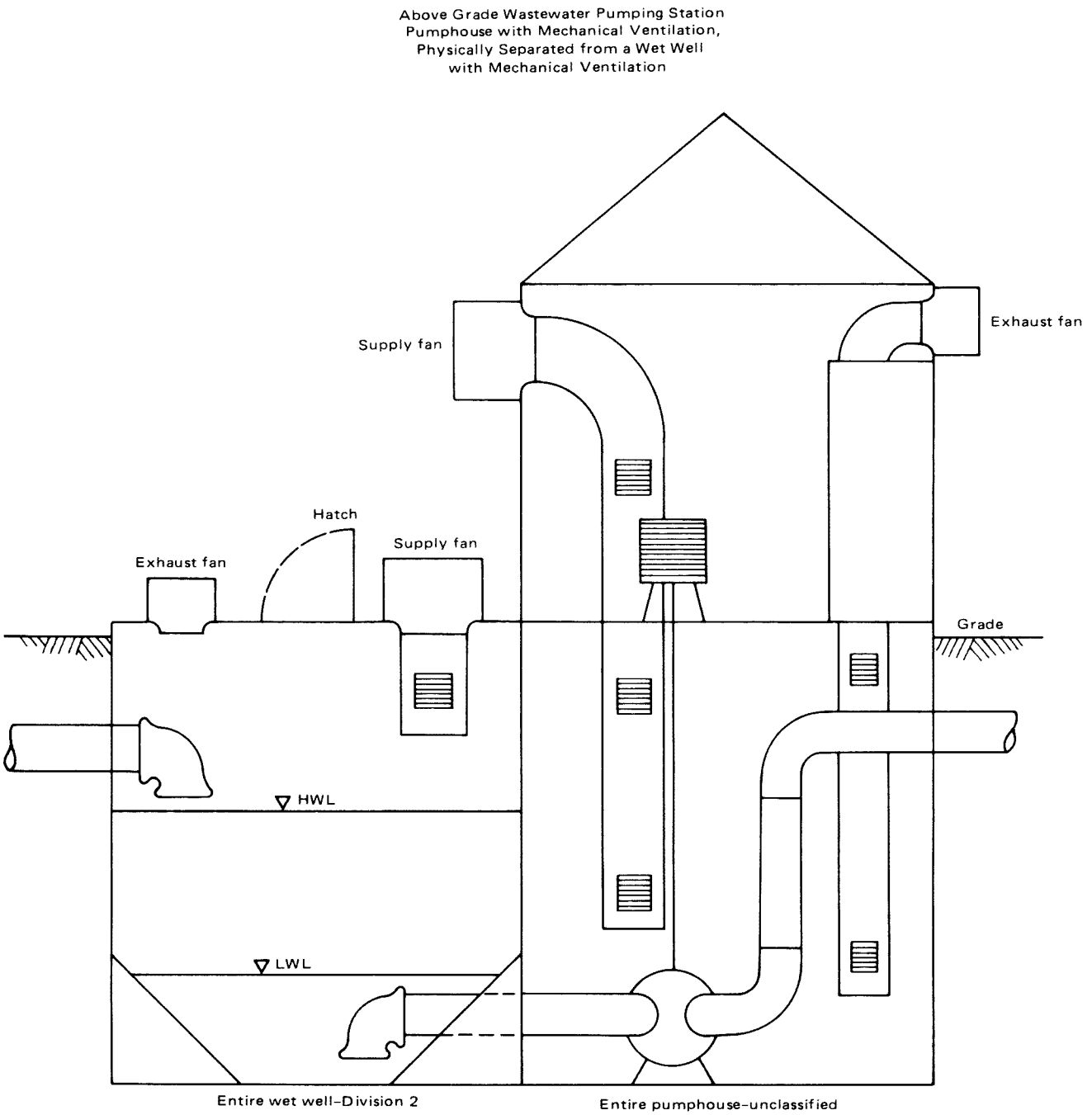

Figure A-2-26 Illustration of Table 2, row 17b.

Submersible Wastewater Pumping Station
Wet Well with Mechanical Ventilation

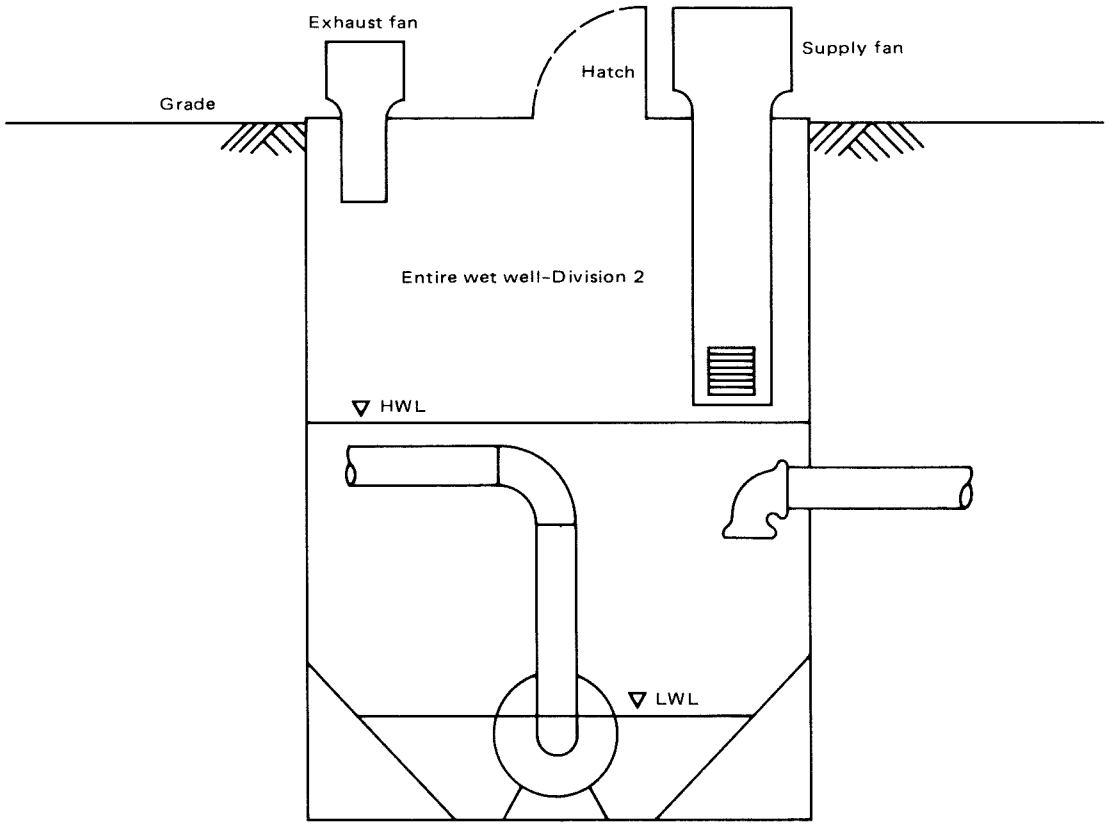

Figure A-2-27 Illustration of Table 2, row 17b.

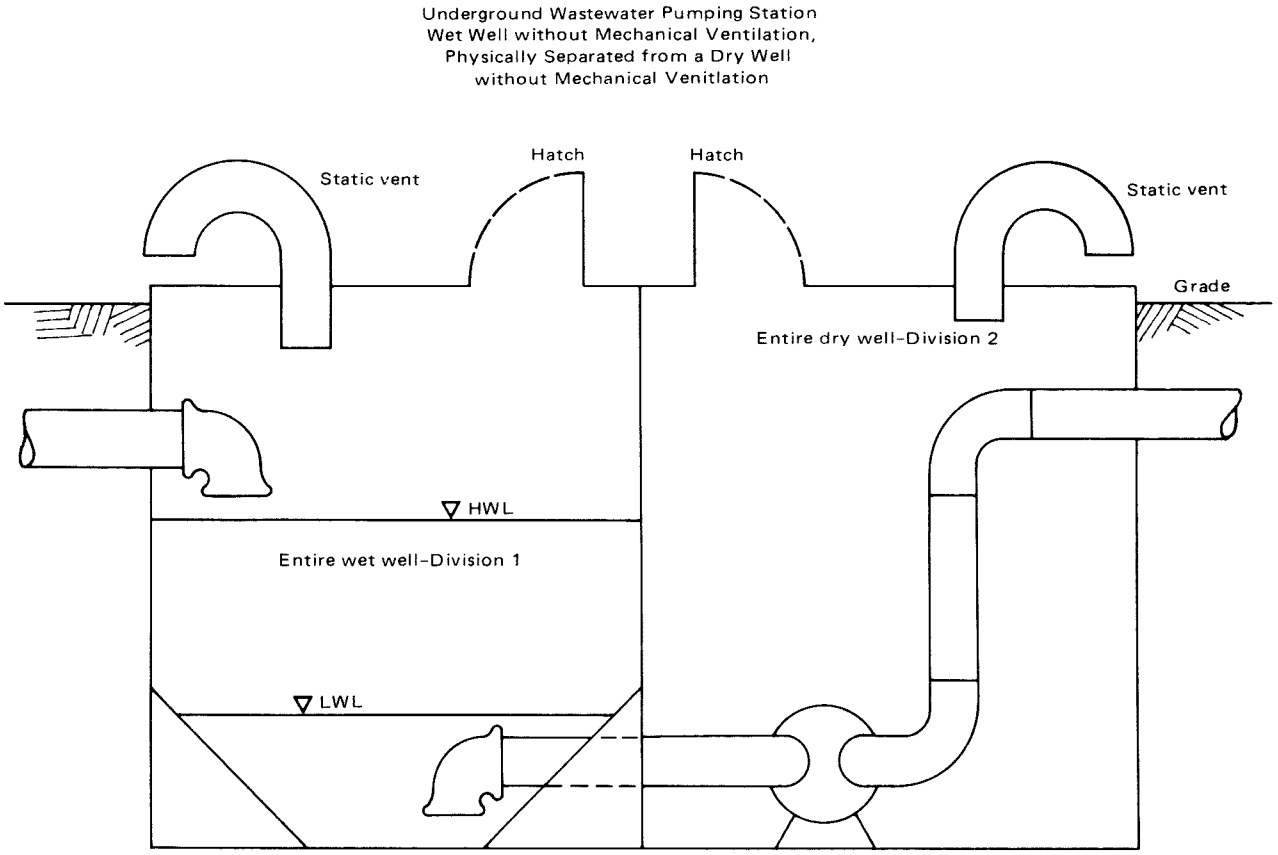

Figure A-2-28 Illustration of Table 2, row 18a.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

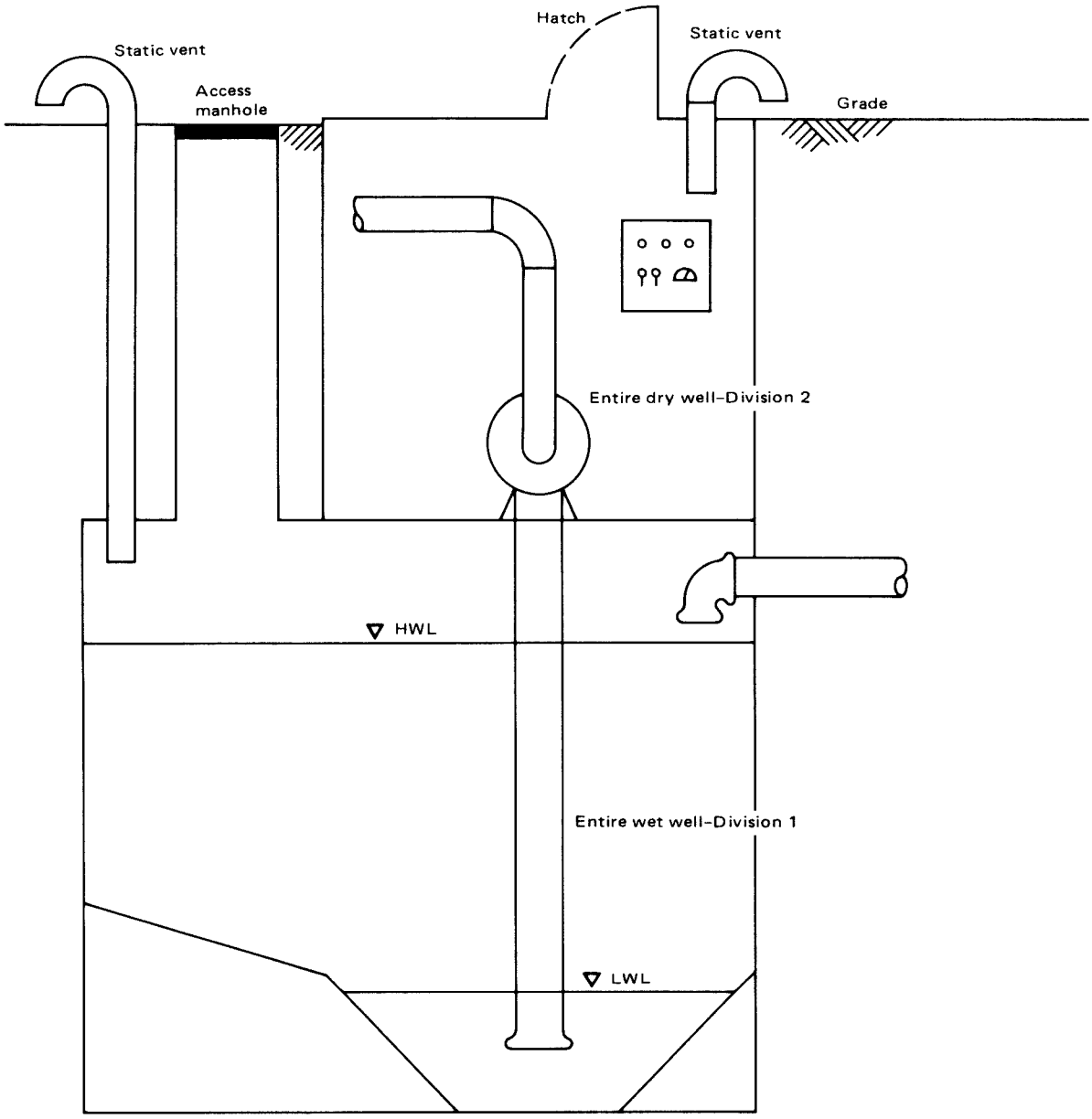

Figure A-2-29 Illustration of Table 2, row 18a.

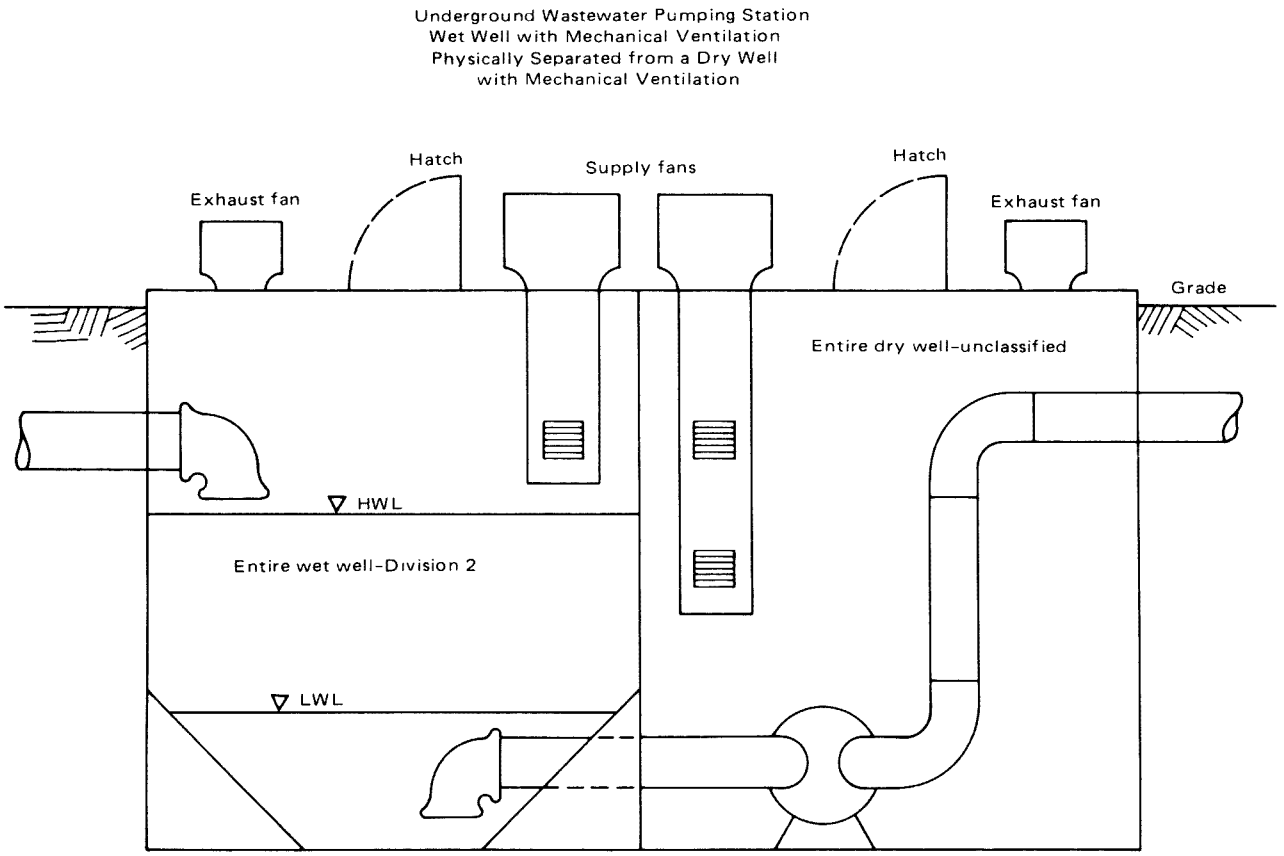

Figure A-2-30 Illustration of Table 2, row 18b.

Underground Wastewater Pumping Station
Wet Well with Mechanical Ventilation,
Physically Separated from a Dry Well
with Mechanical Ventilation

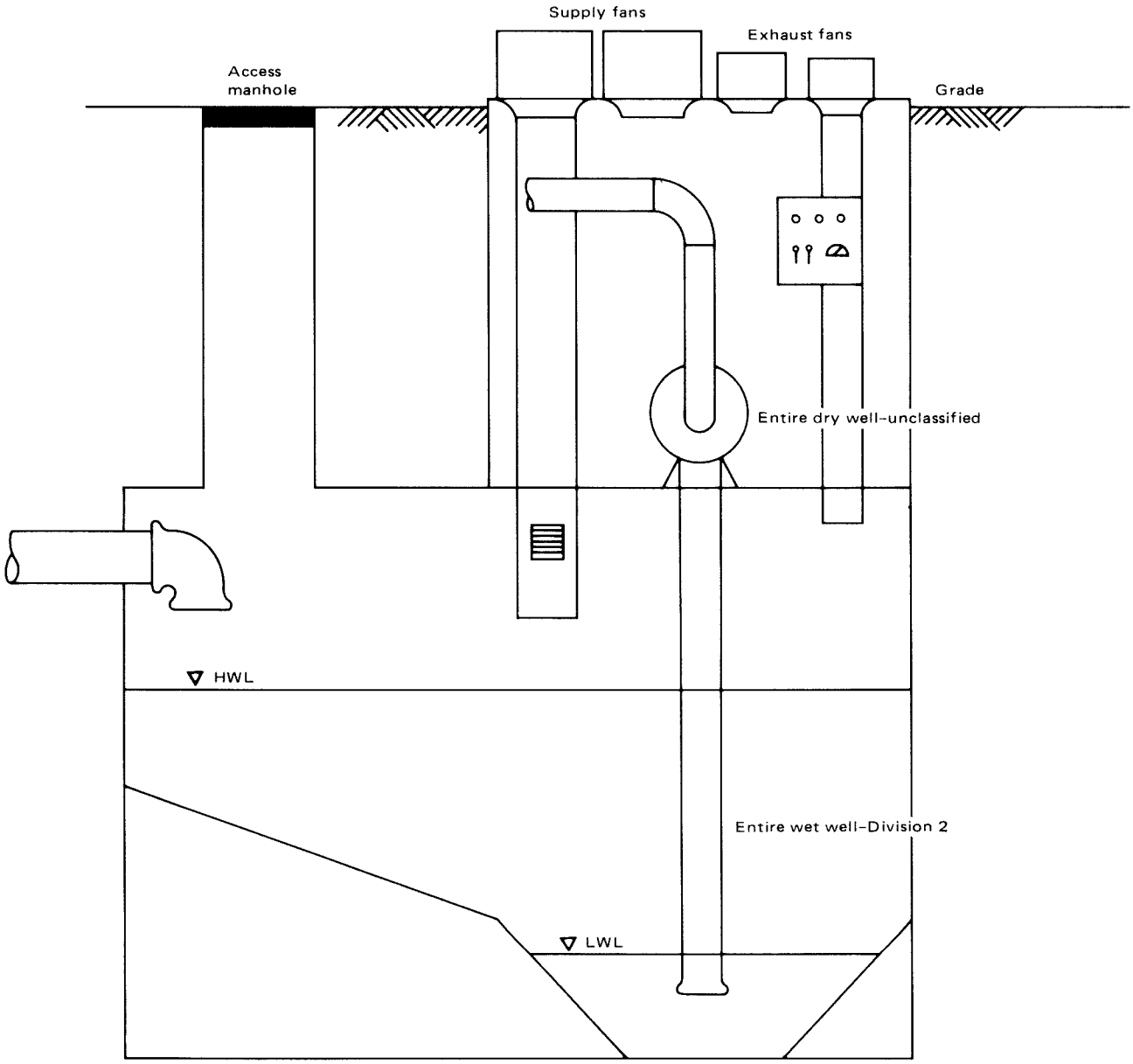

Figure A-2-31 Illustration of Table 2, row 18b.

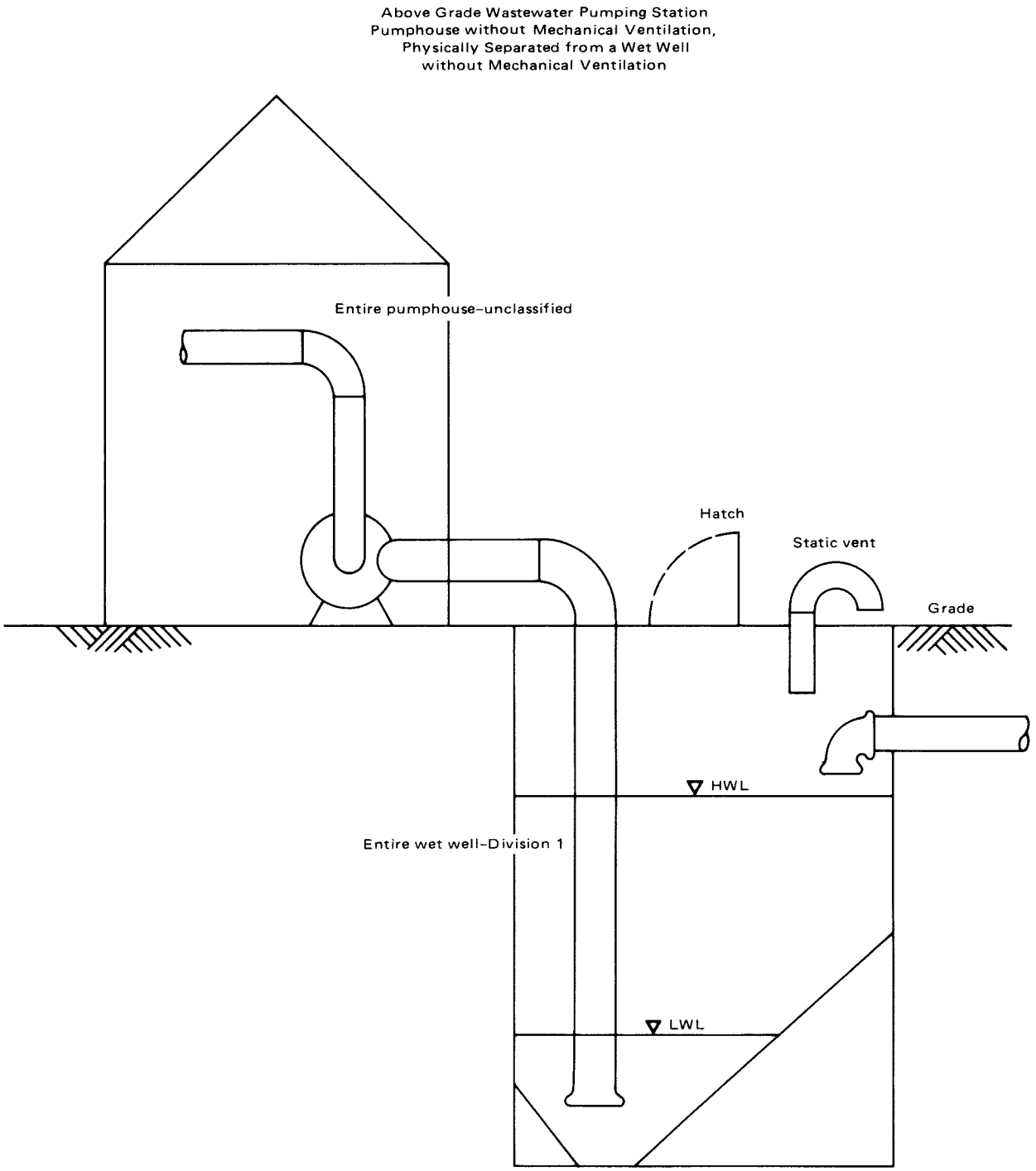

Figure A-2-32 Illustration of Table 2, row 19.

Above Grade Wastewater Pumping Station
Pumphouse without Mechanical Ventilation,
Physicaliy Separated from a Wet Well
without Mechanical Ventilation

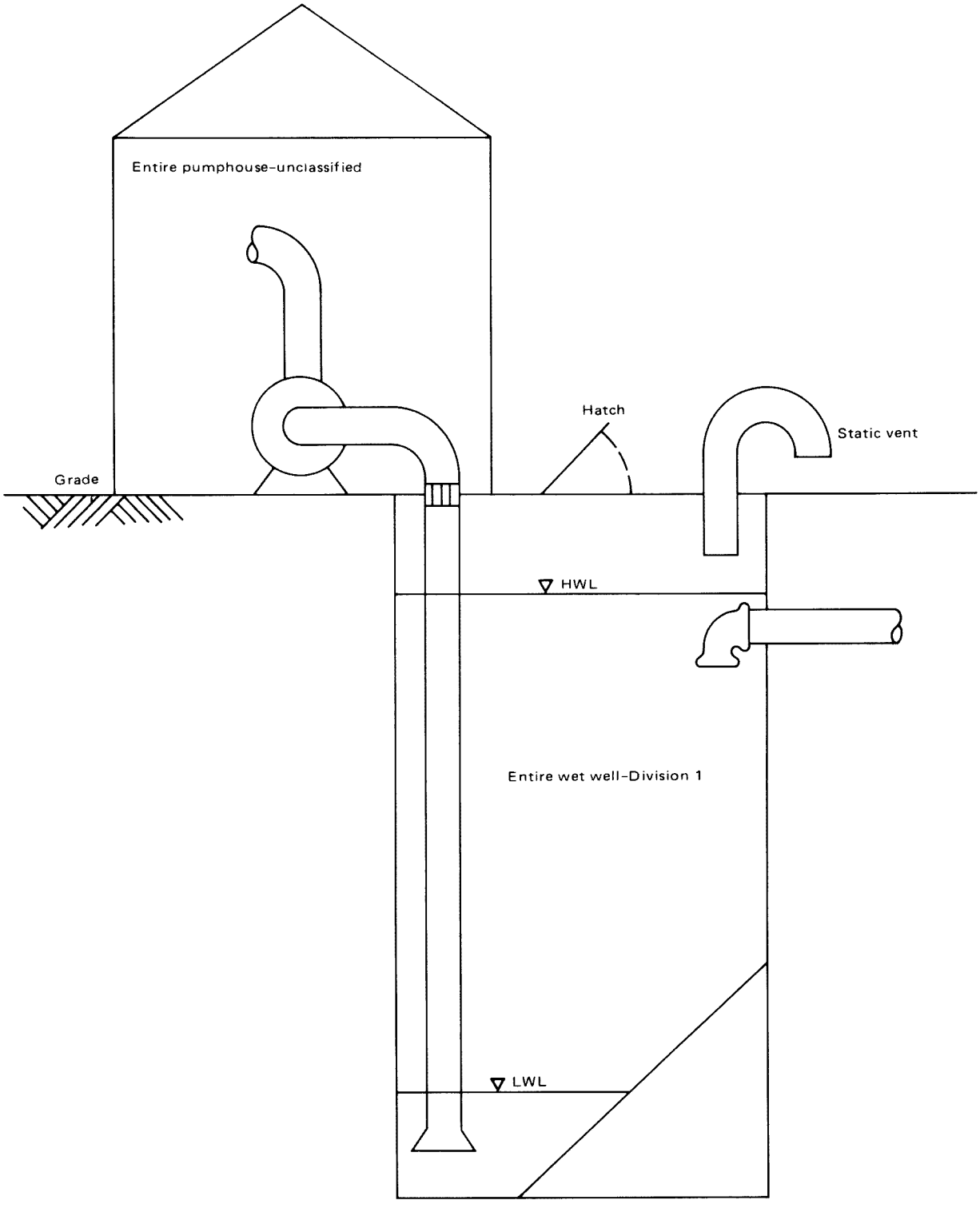

Figure A-2-33 Illustration of Table 2, row 19.

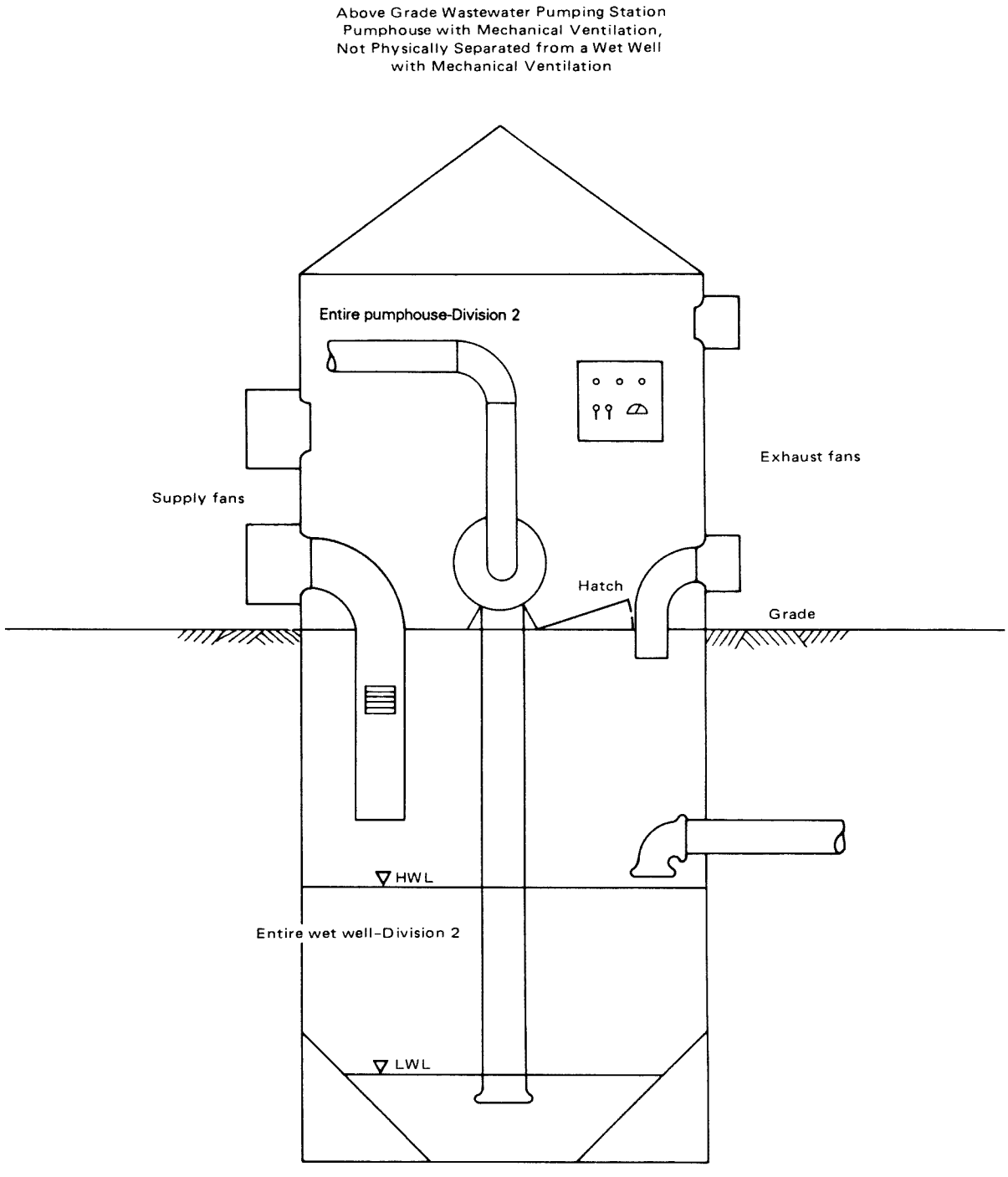

Figure A-2-34 Illustration of Table 2, row 21b.

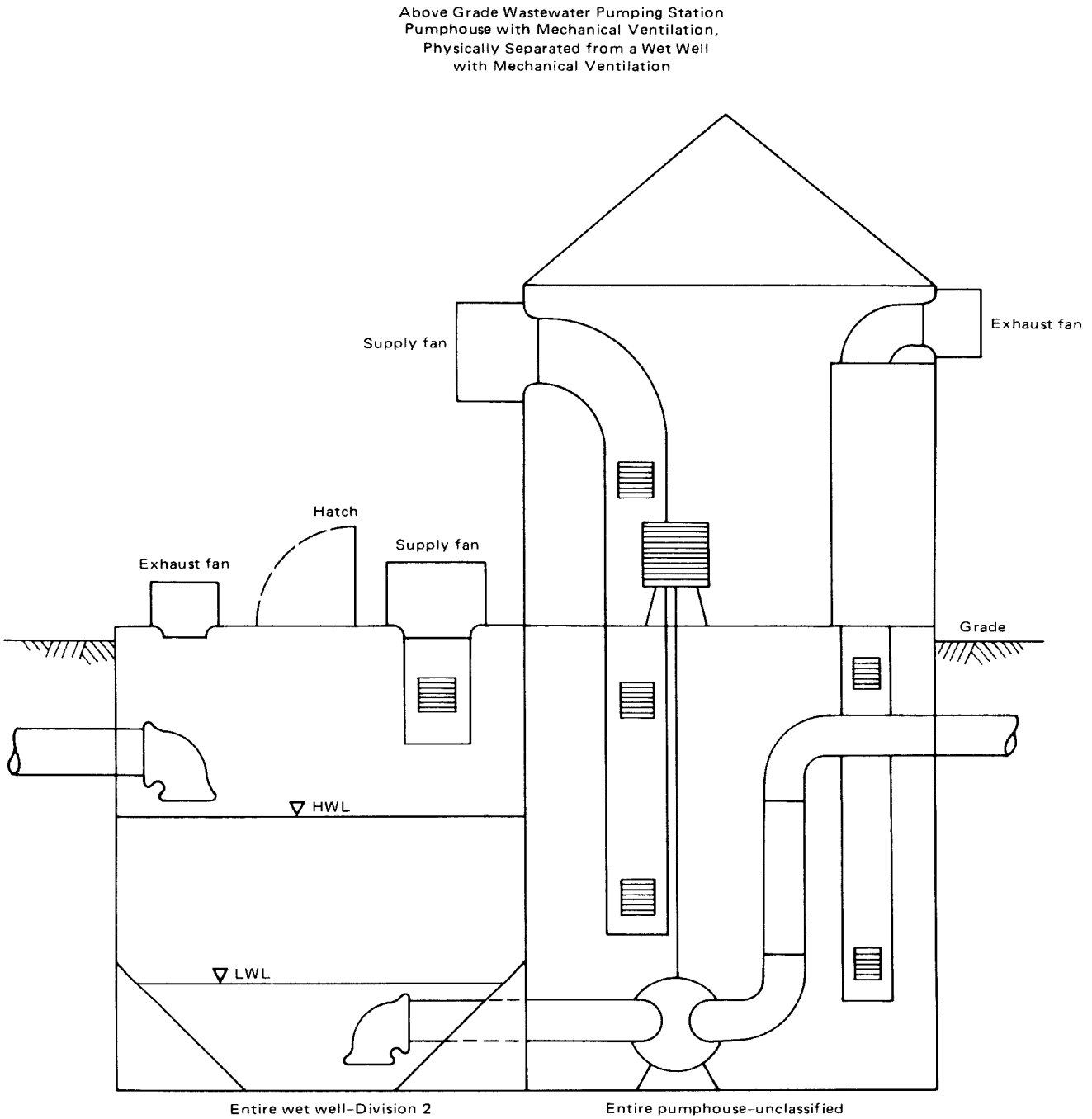

Figure A-2-35 Illustration of Table 2, row 20a.

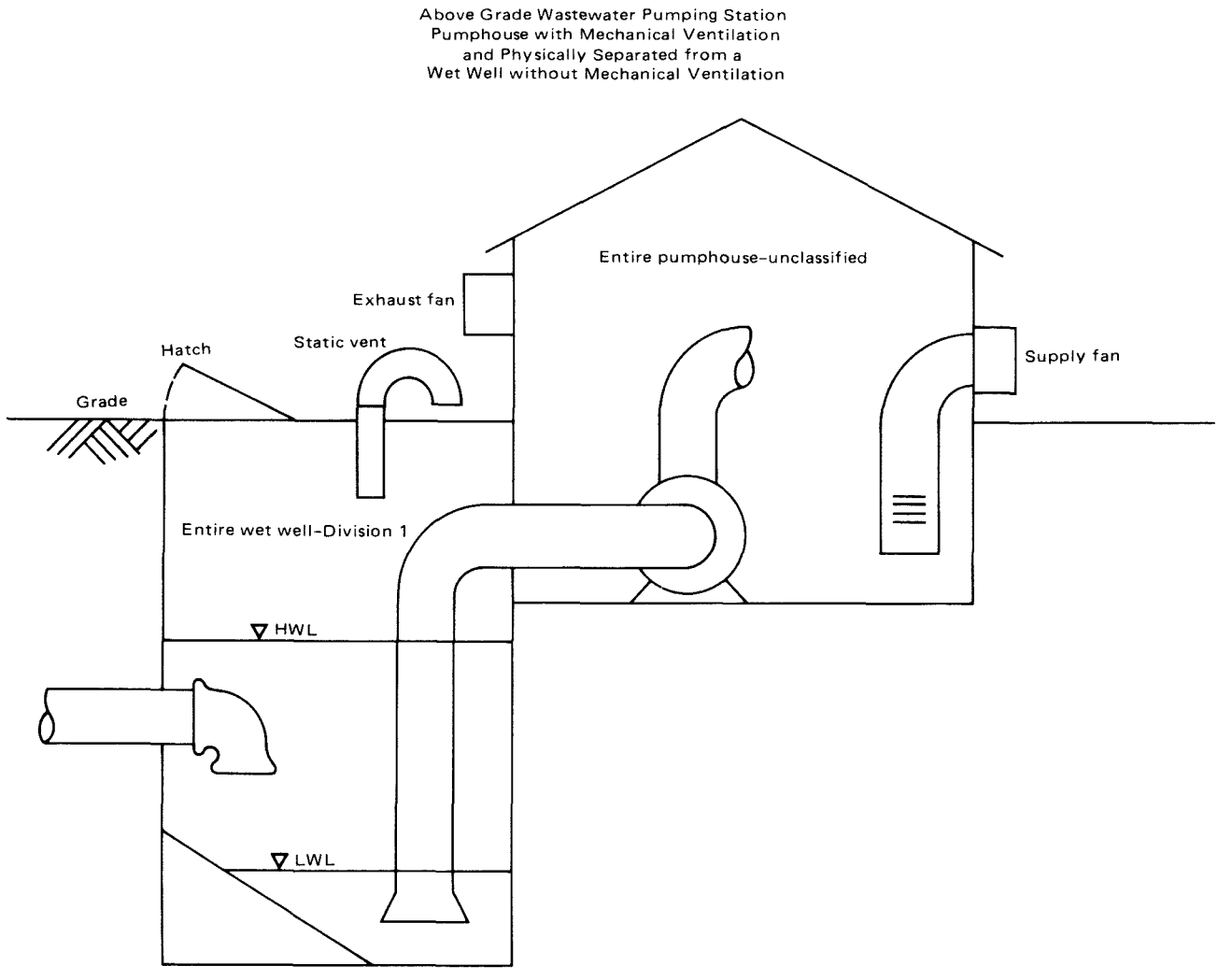

Figure A-2-36 Illustration of Table 2, row 20a.

Above Grade Wastewater Pumping Station
Pumphouse without Mechanical Ventilation.
Physically Separated from a Wet Well
without Mechanical Ventilation

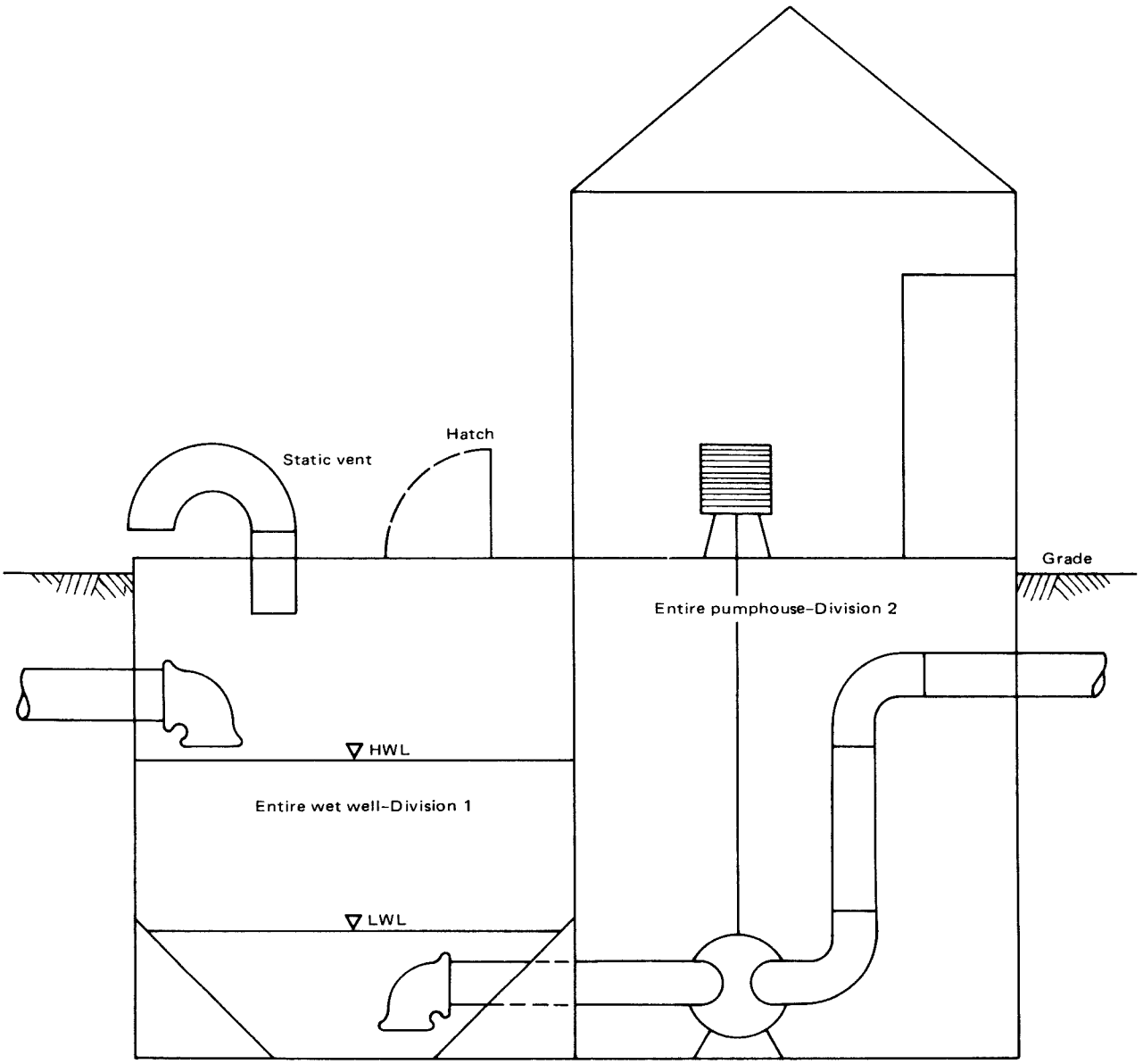

Figure A-2-37 Illustration of Table 2, row 20b.